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FINAL RESULTS OF GASTRIC RESECTIONS FOR CANCER

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A STUDY OF 361 CASES OPERATED UPON IN THE SERAPHIMER HOSPITAL OF STOCKHOLM, SWEDEN DR. A. THOELL SURGEON-IN-CHIEF

SYNOPSIS

Forty years have passed since the first gastric resection at the Seraphimer Hospital was performed for cancer ventriculi, the most common of all malignant tumors in human beings.

What, then, have we to learn from forty years' experience at the Seraphimer Hospital with respect to cancer of the stomach, and its treatment? How much better are we now equipped than forty years ago for the recognition and the combating of this crux medicorum? Are the immediate and lasting results still so poor—in spite of the undeniable diagnostic progress made—that we seem obliged to doubt that we are in such a position? This is a question which, *inter alia,* will be dealt with in this paper, as far as a judgment can be reached with the aid of the—quantitatively—not so inconsiderable material obtained at the above-mentioned hospital.

The first gastric resection at the Seraphimer Hospital was performed (by Berg) July 27, 1887. I shall quote literally from the operative record: "The operation was carried out to-day at 11 A.M. in a room which had been aired and cleaned during the summer, and which had been put in order for the occasion. The temperature of the room was 30° C. and a carbolic spray had been going the whole morning . . ." The expressions employed give us some little idea of the development of surgery during the past forty years.

I. STATISTICAL DATA

The material on which this investigation is based consists of all the operated cases of gastric cancer in the surgical clinics of the Seraphimer Hospital during the period 1887–1926, exclusive of cancer cardiæ. It embraces 361 cases

of resection, 450 cases of gastro-enterostomy, and 339 cases of exploratory laparotomy, *i.e.*, a total of 1150 cases. A number of cases which were not subjected to any operation have not been included, the diagnosis not having been considered as satisfactorily determined, especially during the first few years of the epoch.

Of the 361 resected cases, 260 (72 per cent.) have been submitted to anatomo-pathological examination most regularly during the last twenty years, but the diagnosis, "cancer," with a probability bordering on certainty may be considered as certain in the other cases, too, the histological examination having not been carried out only in those cases of cancer which were macroscopically certain, even as regards the preparation taken out and examined from the inside.

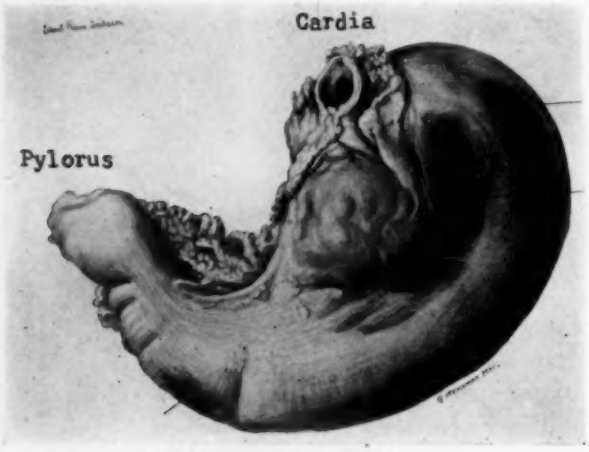


FIG. 1.—Total gastrectomy; drawn from a specimen removed by operation.

Among the cases which have been submitted to gastro-enterostomy, or only to exploratory laparotomy, there have been certainly some instances where cancer did not exist but, instead, ulcus or some other benign affection. Troell[9] has, with respect to a part of this material directly shown, that this is certainly the case, viz., "that diseases assumed on laparotomy to be certain cancer, may later on, have a course which does not readily permit of our maintaining this diagnosis." Of seventy patients who have been submitted to gastro-enterostomy, and 52 who have undergone exploratory laparotomy for supposed inoperable cancer ventriculi, 5 were still alive without any sign of cancer, six, and even eight years after the operation. It must not be forgotten, however, that all these gastric tumors, which had not been radically operated, had only been examined from the exterior of the stomach at the moment of the operation. As the inoperable cases will be mentioned in this paper only *en passant* (their number, at different periods of time, as compared with that of the resection cases), and as, in addition, we may, perhaps, venture to assume that the frequency of erroneous diagnosis in this direction is distributed about uniformly throughout the whole of the period covered by this investigation, these 4 per cent. may be neglected here, although their existence is, *per se*, of great interest.

Resection has been performed on 210 men, of an average age of, very closely, fifty-four (maximum age seventy-six; minimum twenty-nine), and 151 women, of an average age of, approximately, fifty-two and one-half years (maximum seventy-five; minimum thirty).

The greatest frequency of operable cancer, 35.2 per cent. of all the cases, is found within the age-group fifty to fifty-nine years.

II. OPERATIVE MORTALITY AND CAUSES OF DEATH

Of 361 resection cases, 101 (28 per cent.) have died in connection with the operation, or, at all events, in the hospital before they could be discharged. The following table shows the mortality for exploratory laparotomy and gastro-enterostomy too:

Exploratory laparotomy	339 cases—17.1% dead
Gastro-enterostomy	450 cases—23.1% dead
Resection	361 cases— 28% dead

For the sake of comparison, there is given a summary from more recent statistics which have been drawn up by Anschütz and Konjetzny, 1921 [1]:

	Men	Women
Exploratory laparotomy	94 cases—14% dead	45 cases— 4% dead
Gastro-enterostomy	507 cases—32% dead	314 cases—25% dead
Resection	263 cases—41% dead	257 cases—28% dead

Kausch [4] states, from various statistics, a resection mortality varying between 15 and 53.3 per cent.; on an average about 30 per cent. The incomparably lowest operation mortality ever noted in regard to any very great material, is that of the Mayo Clinic, with 13.7 per cent. of 736 resections (October, 1897–1918), *vide* Ch. Mayo.[8] W. Mayo [7] reports that, even in the case of a large material with terminolateral-antecolic gastro-enterostomy, it was found possible to reduce the operation-mortality to no more than 6 per cent.

Although, consequently, the brilliant operative technic of an individual operator may render possible an exceptionally low mortality, it is clear, on the other hand, that, on the whole, the mortality in the case of various operators must very greatly depend on how widely the indications for resection are applied, and also how radically the one operator proceeds as compared with another.

Kausch [4] also points out, *inter alia*, that the immediate operation results have steadily improved during the course of years, and this in spite of the ever-expanding operative technics.

How do matters stand in this respect concerning our material?

The earlier portion of this material has, on a previous occasion, been investigated with respect to operation mortality. J. Waldenström,[11] for the period up to 1910, inclusive, was able to show, out of 123 cases, an operation mortality of 22 per cent. *In contrast with this relatively low figure, we have a mortality of 31 per cent. for the period 1911–1926.*

5-year periods	Total operated cases	Number of resections	Per cent. resections of all operated cases	Operative mortality in resection cases
1887–91	18	7	38.8	57.1 p.c.
1892–96	58	14	24.1	35.7 p.c.
1897–1901	116	23	20	8.7 p.c.
1902–06	136	35	25.7	20 p.c.
1907–11	187	55	29.4	25.4 p.c.
1912–16	209	63	30.1	27 p.c.
1917–21	201	72	35.8	23.6 p.c.
1922–26	225	92	40.9	38 p.c.
	1150	361	31.4	28 p.c.

To be able to obtain a view of the varying mortality percentage at different periods of the forty years, I have made, in the preceding table, a division of the material into five-year periods:

The table shows how the number of resections during the five-year periods have steadily increased from 7 to 92. It shows how the operation mortality first sinks from 57.1 to 8.7 per cent. during the first three periods, after which it almost steadily increases to 38 per cent. Instead of a decrease, we discover, then, an *increase in the operative mortality.*

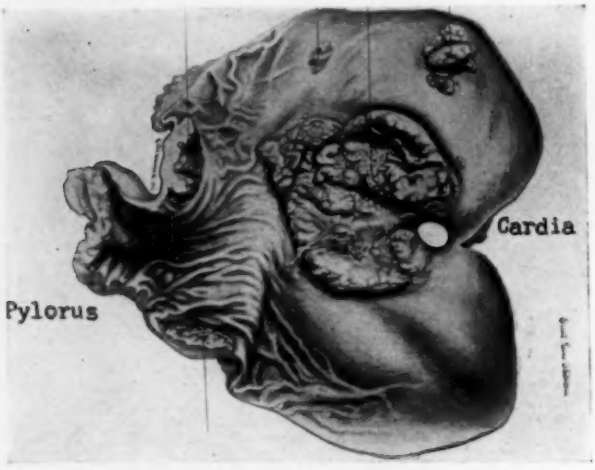


FIG. 2.—Inside of the specimen Fig. 1.

This increase in the first place is due to *widened indications.*

Such are, undoubtedly, good things in so far that they allow to advanced cases, too, an opportunity of obtaining a longer and even more supportable respite period; nay, in some instances, perhaps even of definite health.

Troell[9] has shown that "as contrasted with a post-operative average life of 15–20 months in cases of resection for cancer ventriculi who die later on from a relapse, we have . . . , at the Seraphimer Hospital an average life of no more than 7.5 months after gastro-enterostomy for the same disease." Waldenström's investigations[11] showed that as all resected cases which had lived any length of time, once more showed symptoms only a short time (2–7 months) before death.

That, by means of resection, even advanced cases can, in some few instances, be restored to perfect health, is shown by one of our cases (No. 14, sub iv d), who, after a subtotal gastrectomy for a very severe adenocarcinoma, affecting the entire curvatura minor up to a few centimetres from cardia and down to the pylorus, enjoyed good health for more than eight years, and, at present, both röntgenologically and clinically, is free from any sign of relapse. This case, judging from the skiagram, was inoperable, and the operation could be brought to a conclusion only with considerable difficulty.

The following history * shows that even very advanced cases can, with advantage, be submitted to resection, provided that there is an absence of distant metastasis :

I. 1105/1926. Male, forty-seven years of age. Symptoms since 1923. No palpable tumor. The skiagram showed a tumor infiltration within fornix which pushed cardia and corpus forward; the infiltration extended into the major side of corpus, too. Operation, October 8 (Troell): *Total Gastrectomy.*—A very widely extended ulcerated cancer larger than a fist and going from curvatura minor and extending from cardia to angulus.

* The case is described at length by Troell, Losell and Karlmark.[10]

In addition, there were found a large number of smaller cancer tumors here and there in the stomach, some of them in fornix ventriculi and others in canalis. Between the upper limit of the large tumor and the proximal resection scission through the œsophagus there was a cm. healthy wall. Anatomo-pathological diagnosis (Professor Henschen): Greatly infiltrated adenocarcinoma passing into cancer simplex; farthest proximally all the layers of the normal œsophagus wall were found remaining. Uncomplicated course. March, 1927: Well and able to work.

Figures 1 and 2 show the operation preparation.

On metabolism experiments made after the entire stomach had been removed quite normal conditions were found concerning the possibility of utilizing albumin, fats, and carbohydrates.

That, during the course of the period under discussion, the indications for resection have been steadily increasing can be shown in two different ways.

If we place the number of resections carried out during the various time-periods in relation to the total number of cancer cases treated and verified by operation, we obtain a certain measure of the boldness and activity, or of the caution and reserve which distinguish the surgical treatment in this sphere during the different periods.

These conditions are shown by the table on page 323, or in a graphic representation by the diagram, Fig. 3.

Thus, we are able to show a striking and, I may venture to say, scarcely accidental, agreement between the resection percentage and that of the mortality. As a matter of fact, the phenomenon seems self-evident: the wider the field of indications for resection, the greater the mortality.

A second way of proving the extended indications is the actual investigation of the degree of technical difficulty of the resection material, with the assistance of the operative records.

In this way we find that there has taken place a displacement toward technically more difficult material, and that in an eminent degree.

During the first ten-year period, 80 per cent. of the tumors were localized to the pylorus or its immediate neighborhood, and, according to present standards, were, technically, extremely simple. Simultaneously, there occurred two cases where a large part of the stomach was involved, and where colon resection was necessary. These cases terminated in death. During the last period (1922–1926) only 15.2 per cent. were pylorus tumors. The following table shows these conditions, together with the really lower mortality for the pylorus cancer cases:

	1887–96	1897–1906	1907–11	1912–16	1917–21	1922–26
Pylorus cancer.....	80 p.c.	71 p.c.	59 p.c.	42 p.c.	21.7 p.c.	15.2 p.c.
Their mortality.....	37.5 p.c.	5.3 p.c.	20.7 p.c.	19.2 p.c.	20 p.c.	21.5 p.c.
Total mortality.....	43 p.c.	15.5 p.c.	25.4 p.c.	27 p.c.	23.9 p.c.	38 p.c.

While the number of, from an operation-technical point of view, simple cases, has steadily fallen, the percentage of those which are technically more difficult has increased—among these, too, the number of cases with simultaneous colon resection which, according to all experience, are the most difficult to bring to a conclusion with conservation of life.

Of 19 cases with simultaneous colon resection, 15 have occurred during the last fifteen years. Of these, 8 died in connection with the operation, corresponding to 42 per cent. (as against 28 per cent. for the entire material), a low figure in comparison with corresponding ones in the literature.

Mau[6] communicates a summary of 18 cases from the surgical University clinic at Kiel, up to, and inclusive of the year 1920, besides the 83 cases with sufficiently accurate data hitherto published in the literature. Of all these 101 cases, there died in connection with the operation 55 (about 55 per cent.).

The gain signified by the prospect of cure to advanced cases afforded by the extended indications for resection, must not, however, be obtained at the cost of an altogether too high an operation mortality. This is already high enough to lessen the reputation of surgical treatment as a remedy for cancer of the stomach, as many a patient, perhaps even in an early stage of the disease, may thereby become afraid to submit to operation, preferring to allow the cancer to run its course some months to running the risk of a very dangerous operation, wherein life may be risked. The aim should be, that increased technical skill, based on massed experience, will be able to allow of extended indications without any increase in the mortality. That this aim is not out of reach is shown by the figures from the Mayo Clinic, cited above.

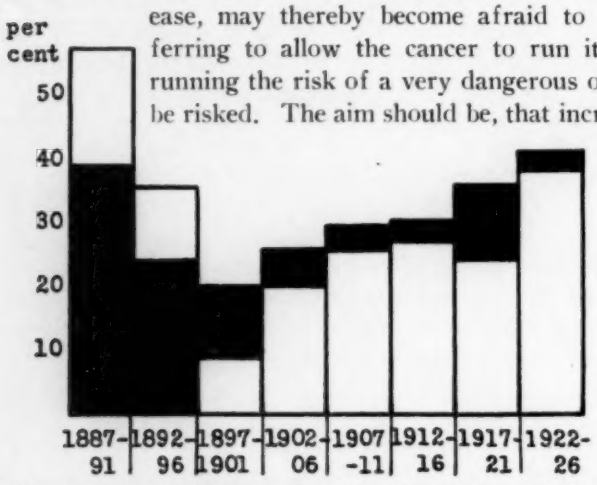


FIG. 3.—The tops of the white columns show the operation-mortality in percentages; that of the black, the percentages of resection.

There also exists a special factor to be emphasized here as an evidence that the cancer operation material, during the course of years, has grown more difficult from a technical point of view. In Sweden (as everywhere else) the entire development of "stomach surgery" has taken place during the forty years embraced by this paper. At first the Seraphimer Hospital was almost the only place in the country where resection was ever performed. By degrees, this condition of things has been so far altered that such operations are carried out on an increasing, and, very often, fairly great scale in hospitals all over the country. What, now, were the cases which at first were submitted to operation? Well, cases with retention vomiting, almost all of them with palpable tumor in the region of pylorus. The others, as a rule, were not diagnosed before they had become inoperable. Nowadays, the number of resections at the Seraphimer Hospital has steadily increased, in spite of this being the case, too, at other hospitals all over the country. This signifies that a number of technically more difficult cases have come to operation, and that pylorus cancers, during the last few years have constituted the minority. For, presupposing that the frequency of gastric cancer in Sweden has been approximately equally numerous during all these years (Nyström's figures for 1905 and 1911 speak strongly in favor of this hypothesis), then the unheard-of increased operation frequency must, of itself, point to many more difficult cases now being included, and thus contributing to increasing operation mortality at the hospital. The progress made in Röntgen examinations has played a great part in this matter besides.

The increase in the operative mortality is, in the second place, in a measure due to a peculiar and great displacement of the material from feminine to masculine excess.

Most agree that women have a greater power of resistance to operations than men. In the material from the Seraphimer Hospital, the men have displayed a mortality which is more than 50 per cent. greater than that of the women. Of 210 men operated there died 69 (32.9 per cent.), while of 151 women operated, 32 died (21.2 per cent.).

In the period 1887–1896, the women constituted 71.4 per cent. In the period 1922–1926 only 29.3 per cent. In graphic representation, this peculiar displacement is illustrated as shown by Fig. 4.

Causes of Death.—In this paper, there has been reported, as cause of death, intra-abdominal complication in every case where it has been possible to prove its existence. This has been done even if a simultaneous pulmonary affection or any other contributory cause of death has existed. Seventy-one patients (19.6 per cent. of all the cases operated) have died of abdominal complications. Eighteen (5 per cent.) have died of pulmonary complications.

In addition to these, there have been proved, in 12 cases, causes of death which have been of a more accidental character; operative shock in three instances; chloroform intoxication in two cases; heart failure in five cases (one vitium organic. cordis; the others myocarditis); uræmia e nephrocirrhosi ren. solitar., and status epilepticus e tumor cerebri metastat., one case of each. In these twelve cases there was an absence of clinical signs of lung or abdominal complications, and all, with exception of two, have been dissected.

Pulmonary complications are not of the same value for judging the advantages and disadvantages of the different methods of operation, as abdominal complications are. They will be dismissed, therefore, in a very few words.

In 1 case was present pulmonary embolism twelve days after operation, a fairly troublesome Billroth II, with liver and pancreas resection. In 2 cases the cause of death was pleural empyema; in 3 cases pulmonary gangrene, and, finally, in 12 cases, postoperative pneumonias. In all the latter (with the exception of a woman, forty-two years of age, with simultaneous goitre and pulmonary emphysema), the patients were sixty years of age and more; 4 of them were even as old as seventy or seventy-five.

Abdominal complications will now be the object of our investigation. As will be seen by the accompanying table, their frequency has been fairly equal during the last two decades.

10 year periods	Number of resections	Total dead in complications	
		Pulmonary	Abdominal
1887–96	21	2 (9.5 p.c.)	5 (23.8 p.c.)
1897–1906	58	0	9 (15.5 p.c.)
1907–16	118	4 (3.4 p.c.)	23 (19.5 p.c.)
1917–26	164	12 (7.3 p.c.)	34 (20.7 p.c.)
	361	18 (5 p.c.)	71 (19.6 p.c.)

The following table shows the frequency of different complications according to the different methods of operation:

Resection	Number of cases	Primary deaths	Complications		
			Intra-abdominal	Pulmonary	Other
Segmentary.....	2	2	2	..	..
Transverse.....	9	2	2	..	..
Billroth I.....	32	12 (37.5 p.c.	6 (18.7 p.c.)	3 (9.4 p.c.)	3
Kocher.....	4	1	1	..	
Billroth II.....	210	44 (21 p.c.)	30 (14.3 p.c.)	8 (3.8 p.c.)	6
Polya*.....	101	38 (37.6 p.c.)	28 (27.7 p.c.)	7 (7 p.c.)	3
Total gastrect.....	3	2	2	..	..
	361	101 (28 p.c.)	71 (19.7 p.c.)	18 (5 p.c.)	12

* In Sweden, this was, from the very beginning, advanced independently by Rissler.

The term "abdominal complication" comprises many different kinds of complications. The following table shows, as briefly as possible, the various abdominal complications that have occurred, and their relative frequency:

Intra-abdominal bleeding	1
Necrosis of pancreas	2
Diffuse peritonitis	42
Circumscribed peritonitis	16
Ileus	7
Fistula—Marasmus	3
	71

In the 58 cases of peritonitis, suture insufficiency was stated in 23 of them; its absence in 24 cases. Seven cases were not dissected.

The only instance of lethal bleeding that has occurred was in the case of a patient, thirty-seven years of age, a man very much run down and cachectic (1889) with a pylorus cancer, adherent to the pancreas. On performing the pancreas resection thus rendered necessary, there arose a very severe bleeding which it was possible to arrest, however, by means of ligatures. The patient died three days after the operation. The dissection exhibited one-half litre of blood in the abdominal cavity, and a completely bloodless patient.

In 2 cases, the cause of death was necrosis of the pancreas. In the one instance, there existed simultaneously a phthisis pulmonum which was diagnosed before the operation, and, in the other case, a bronchopneumonia, these being contributory causes of death.

III. METHODS OF OPERATION AND ABDOMINAL COMPLICATIONS

Peritonitis, ileus, and post-operative fistula formation are really the abdominal complications that can be of some importance when judging of the relative values of the different methods of operation.

Of 32 cases, operated according to Billroth I, 12 (37.5 per cent.) died, 6 of whom in intra-abdominal complications: bleeding and necrosis of the pancreas (1 case of each); diffuse peritonitis (3 cases, two of them originating from a suture insufficiency in the angle between the stomach suture and the gastrodudenostomy), and, finally, 1 case of paralytic ventricle-ileus the third week after the operation.

In the last-mentioned case, nearly the whole curvatura minor and more

than a half of the major had been removed. There was attempted secondarily, without success, gastrostomy and anterior gastro-enterostomy with entero-anastomosis.

Of 210 cases operated according to Billroth II, there died 44 (21 per cent.), 30 of whom (14.3 per cent.) in abdominal complications: necrosis of the pancreas (1 case); peritonitis (27 cases); strangulation ileus and fistula of the duodenum with marasmus (1 case of each).

Of the cases of peritonitis, 18 were diffuse and 9 circumscribed. In 11 cases there was proved on dissection suture insufficiency; in 11 cases, too, there was found (as far as could be judged on dissection) its absence, while, finally, in 3 cases was no dissection carried out. In 2 cases, the peritonitis was caused by circumscribed gangrene of intestines. In one of these cases, relaparotomy had had to be performed in consequence of a colon stricture within a too short, antecolic-laid jejunal loop. In other case, there existed infarction of a portion of transverse colon. During operation "several fairly thick branches of art. colica media" had had to be ligated in consequence of extensive adhesions of tumor to mesocolon and colon transversum. It is said that, during operation, there were observed no signs of nutrition disturbances of colon.

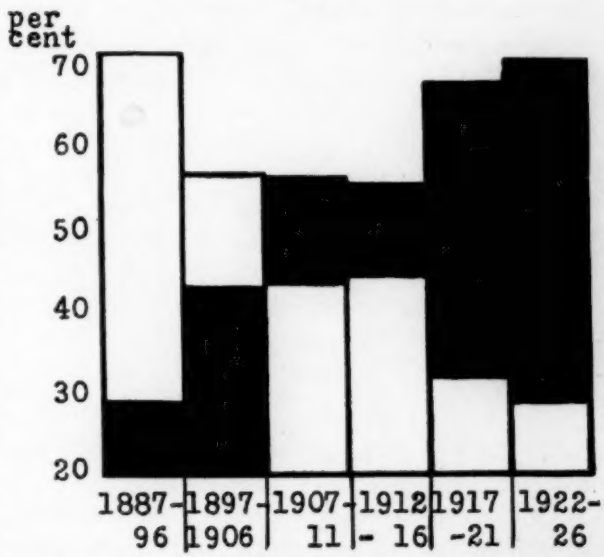


FIG. 4.—The tops of white columns show the number of women in percentage of the whole number of resection material; the black columns are the men, in percentage.

The suture insufficiency was in 9 of the 11 cases localized to the stomach suture or gastro-enterostomy; in 2 cases to the duodenal stump. In one of the latter cases, a little tampon had been laid against the duodenal stump, a considerable amount of duodenal contents having issued. A couple of days after the removal of the tampon, there began a flow of bile through the laparotomy wound. The patient died three weeks after the operation, with duodenal fistula, circumscribed peritonitis and phlegmon of the abdominal wall.

In the above-mentioned case of duodenal fistula with marasmus, the duodenal suture had had to be laid in infiltrated tissue. Death one month after operation.

Of 101 cases, operated according to Polya, there died 38 (37.6 per cent.), 28 of whom (27.7 per cent.) in abdominal complications: peritonitis (21 cases); ileus (5 cases), and fistula ventriculi + marasmus (2 cases).

The peritonitis was, in 17 cases, diffuse, and in 4 circumscribed. Suture insufficiency was found in 7 cases; its absence in 12 cases, and, finally, no dissection was made in 2 cases. It was, in 3 cases, to be sought for at the duodenal stump; in 4 at the place of the gastro-enterostomy.

In additional 2 cases there occurred suture insufficiency, but without any actual peritonitis. They had been drained in consequence of the issue of stomachic contents and parenchymatous bleeding, respectively. Two to three days after operation there appeared ventricle fistula and the patients went to exitus in somewhat more than one month after continued inanition.

The 5 cases of ileus were all of a purely mechanical nature; dilatatio permagna duodeni in consequence of the overfilling of the afferent gastro-enterostomy loop (2 cases); incarceration of the small intestine in the mesocolon aperture (2 cases); a sharp turn in the middle of transverse colon due to adhesion to the operation wound (1 case), the symptoms arising thirteen days after operation. Relaparotomy; cæcal fistula; in vain.

On the whole, then, it is the same complications that arose after the Polya operation and after Billroth II, although, after Polya, the number of complications was considerably greater. With a number of operations according to Polya, less than half the number of those performed according to Billroth II, there have occurred only 2 abdominal complications less than with Billroth II; only 6 cases of peritonitis less (21 as against 27), of which, practically speaking, there were just as many diffuse (17 as against 18); more than half as many cases of suture insufficiency (7 as compared with 11, or, if, in addition, the post-operative fistulas with marasmus be counted to, 9 as against 11), and, finally, a considerably greater number of post-operative ileus (5 to 1).

It should be remarked, however, that, taken as a whole, Billroth II has probably been employed on a technically, somewhat easier material than Polya (earlier in the statistics).

IV. LATE RESULTS

Respect has been paid only to the cases where the operation took place more than five years back; those, consequently, up to and inclusive of the year 1921. Only 3 of the surviving patients have not been found. The following table forms a report of the fate of the patients who were operated on more than five years ago:

Number operated on during the years 1887–1921	269	
Operative mortality	66	(24.5%)
Discharged alive	203	
Of these, have not been found	3	
Patients with complete post-operative data	200	
Of these, dead within five years, most after relapse	161	(80.5%)
More than five years after operation died of relapse	12	
More than five years after operation died of another disease	9	
Living, healthy (six and a half to twenty years after operation)	17	
Living, healthy?	1	

a. *Patients Dead of Relapse in Five Years After Operation.*—Of 161 deaths in five years, probably all, with the exception of 2, have been caused by relapse (1 pneumonia after four years; 1 suicide after three years).

In the first year: died, 61; in the second, 61; in the third, 26; in the fourth, 9; in the fifth, 4.

Thus, 53 patients (26.5 per cent.) have lived more than three years after operation; 39 (19.5 per cent.) more than five years.

For the sake of comparison, there are given here Nyström's[8] corresponding figures for the whole of Sweden. Of 225 cases radically operated during 1911, there died in connection with the operation 46. Respecting 7 more, no information could be obtained respecting the further course. Of 172 cases that could be investigated later, 38 (22.1 per cent.) lived more than five years.

Although, therefore, most of the patients that died in relapse, did so within three years, there remain, as is shown by the above table, sufficiently many deaths in relapse after three, nay even after five years, to clearly show that, in the individual case, there is always a fear, even after the lapse of a considerable number of years, of the hope of a radical cure being spoiled.

b. *Patients Dead in Relapse Later Than Five Years After Operation.*—Twelve died; these cases are tabulated below:

No.	Operation	Tumor loc.	Metastases	Microscopic	Died after operation
1	Billroth II	Pylorus	0	Malign papilloma	14 yrs. 6 mos.
2	Billroth II	Pylorus	0	Adenocarcinoma	6 yrs. 1 mo.
3	Billroth II	Pylorus	0	Cancer	7 yrs. 1 mo.
4	Billroth II	Pylorus	0	Adenocarcinoma	5 yrs. 7 mos
5	Billroth II	Pylorus	0	Cancer	17 yrs. 0 mos.
6	Billroth II	Pylorus	0	Ulcus carcinomat.	5 yrs. 4 mos.
7	Billroth II	Pylorus	0	Adenocarcinoma	10 yrs. 2 mos.
8	Billroth II	Pylorus	0	Cancer gelatinos.	8 yrs. 8 mos.
9	Billroth II	Pylorus	Ca. lymphogl.	Adenocarcinoma	5 yrs. 4 mos.
10	Billroth II	Pylorus	0		7 yrs. 9 mos.
11	Polya+Col. res.	Curv. major	0	Cancer scirrhos.	6 yrs. 6 mos.
12	Billroth II	Curv. minor, up to pylorus	0	Cancer	7 yrs. 5 mos.

Many different histological types of cancer are thus represented. A distinguishing feature of these late relapses is, that in most cases, the cancer has been localized to the pylorus and its most immediate neighborhood; this, with really but one exception. In this, the cancer was localized in curvatura major, at the beginning of the transverse part of the stomach and going on to mesocolon, with a drawing up of the colon. In addition, only in one case has cancer been proved to exist in regional lymphatic glands. In all the other cases, any possible glands have been soft and, judging from palpation, it has been possible to remove them to a satisfactory degree, and, in the cases that have been examined microscopically, have been cancer-free.

In all these cases, the patients have, subjectively, been in good health for several years after the operation, and it has only been from some months to half a year before death that they have once more felt their former ailments, with emaciation, vomiting, and, in certain instances, ascites, jaundice, etc. There has, thus, been a palliative result, which must be regarded as extraordinary.

Case No. 1 in the table is the only one where the relapse has not been fully proved (by dissection, relaparotomy, hospital care, etc.). The clinical symptoms, which developed during the last year of the woman's life, were described by her surviving son; the communication could not be interpreted any other way, however, than that the cause of

this patient's death was a relapse of the cancer. J. Waldenström[21] makes public a case of relapse thirteen years after operation: Male, fifty-eight years of age. Operation 1897 (Berg): Adenocarcinoma, commencing at curvatura minor. Patient died 1910 of influenza. Dissection displayed an extensive relapse in the stomach.

c. *Patients Dead of Another Disease Later Than Five Years After Operation.*—Nine died.

No.	Operation	Tumor loc.	Metastases	Microscopic	Died after op.	Cause
1	Billroth I	Pylorus	0		14 yrs. 6 mos.	Suicide.
2	Billroth II	Pylorus	0	Cancer	9 yrs.	Ca. coli.
3	Billroth II	Pylorus	0		15 yrs.	Ca. recti.
4	Billroth II	Pylorus	0	Adenocarcinoma	7 yrs. 4 mos.	Tub. pulmon.
5	Billroth II	Pylorus	Cancer lymphogl.	Cancer	5 yrs. 8 mos.	Senility.
6	Billroth II	Curv. minor	Cancer lymphogl.	Cancer	9 yrs. 6 mos.	Senility.
7	Billroth II	Curv. minor	0	Cancer simpl.	9 yrs. 10 mos.	Anemia.
8	Billroth II	Curv. minor	0	Cancer	13 yrs. 6 mos.	Senility.
9	Billroth II	Curv. minor	0	Adenocarcinoma	7 yrs. 11 mos.	Appendicitis.

In all these cases the cause of death is stated by physicians: In 6 of them during the patient's stay in a hospital, in spite of which *some of the cases seem to me to be suspected to have been cancer relapses, too.*

Below are given some brief casebook extracts respecting the patients. The numbers refer to the above table:

1. II. 54/1892. Male, thirty-four years of age. Symptoms for one and a half years. Palpable, movable tumor. Retention. Operation 19/2 (Berg): *Billroth I.*—Kidney-like cancer surrounding pylorus. The patient hanged himself 1906. No symptoms of relapse.

2. I. 29/1900. Male, forty years of age. Symptoms for half a year. No palpable tumor. Operation 11/1 (Berg): *Billroth II.*—Pylorus tumor. Histological: polymorphous-celled, in part very cell-rich cancer. Healthy until 1908. Operated in January, 1909, for an adenocarcinoma in the sigmoid flexure, at the Seraphimer Hospital. Died of post-operative peritonitis. *Dissection showed stomach and surrounding lymphatic glands macro- and microscopically free from cancer.* No macroscopic cancer anywhere else either.

3. I. 783/1901. Female, fifty-one years of age. Symptoms two months. Palpable, movable tumor. Operation 19/12 (Berg): *Billroth II.*—Mandarin-orange-sized tumor in posterior wall close to pylorus. Died 8/11, 1916, in rectal cancer.

4. I. 72/1904. Male, fifty years of age. Dyspeptic symptoms for many years. Now, for one-half year vomiting and emaciation. Palpable, movable tumor. Retention. Pulmonary tuberculosis. Operation 31/10 (Berg): *Billroth II.*—Extended pylorus tumor. Adhesions to pancreas. Regional glands enlarged. Histologic: Adenocarcinoma. Patient examined 1910: Advanced, double-sided pulmonary tuberculosis. In other respects healthy. He died of pulmonary tuberculosis at another hospital 11/3, 1912. No relapse.

5. I. 613/1911. Male, sixty-six years of age. Symptoms for two years back. Operation 9/8 (Nyström): *Billroth II.*—Pylorus tumor. Histological diagnosis: Cancer in pylorus and in glands from omentum. Patient died 11/4, 1917, at another hospital in senile gangrene. No sign of relapse.

6. I. 778/1911. Male, sixty-six years of age. Symptoms for a month back. No palpable tumor. No retention. Operation 23/9 (Lidén): *Billroth II.*—5-6 cm. broad tumor on anterior wall, at curvatura minor, proximally to the pylorus. Histological

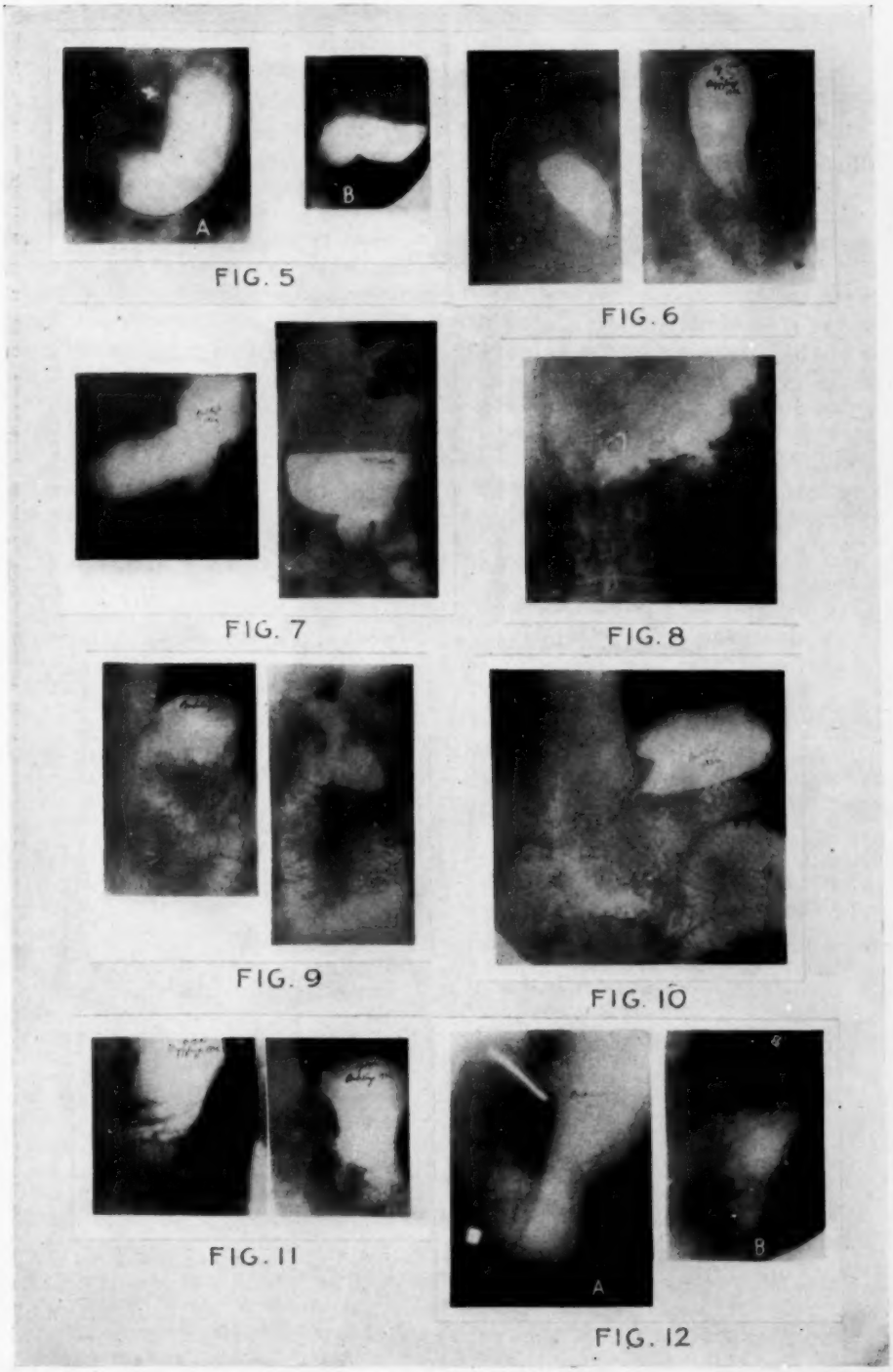


FIG. 5.—Skiagram from Case 8 (Sub.IVC) A. Before operation. B. 13 years after operation. FIGS. 6–12.—Skiagrams from cases 3, 5-10 (Sub. IVd). A. Signed before operation. All others at post-investigation.

diagnosis: Cancer, also in lymphatic glands from omentum minus. Patient died, seventy-six years old, 10/4, 1921, of old age. No sign of relapse.

7. I. 955/1911. Female, sixty-one years of age. Operation 22/11 (Berg): *Billroth II.*—Tumor as large as a fist. A few glands regionally. Histological diagnosis: Carcinoma simplex. Patient died 2/9, 1921, at age of seventy-one of anæmia. Is said to have exhibited no signs of cancer relapse, but seems to me suspected.

8. I. 1168/1912. Female, sixty-seven years of age. Symptoms for three months back. Palpable tumor. X-ray (Fig. 5A): In canalis, a defect as large as a mandarin-orange, with uneven, ragged edges. After five hours great retention. Operation 12/12 (Berg): *Billroth II.*—Tumor, as large as an orange in pars pylorica, extending somewhat up into curvatura minor. Regional, soft glands. Histological diagnosis: Cancer. Patient died of old age at eighty-one, at another hospital, on 5/6, 1926. X-ray 13/11, 1925, (Fig. 5B): The lower part of the stomach remainder shows an uneven contour, but not more than is usual with resection stomachs in general. No certain cancer infiltration. After four hours there were some slight rests in the stomach.

9. I. 220/1915. Male, fifty-three years of age. Symptoms for three months previously. No palpable tumor. X-ray: Tumor defect in canalis, immediately below angulus of the size of a walnut. Inconsiderable retention after four hours. Operation 19/3 (Berg): *Billroth II.*—Large tumor, starting from the posterior wall of the stomach, at curvatura minor, with large crater. Histological diagnosis: Adenocarcinoma. Patient died at another hospital 18/2, 1923, of gangrenous appendicitis with peritonitis. No relapse.

d. *Patients Still Alive, More Than Five Years After Operation.*—Eighteen patients are living, six to twenty years after operation.

No.	Operation	Tumor loc.	Metastases	Microscopic	Lived after oper.
1	Billroth II	Posterior wall	Glands (nature ?)		20 years
2	Billroth II	Pylorus	Glands (nature ?)	Cancer	19 years
3	Polya	Pylorus	Glands (nature ?)		18 years
4	B. II+Col. res.	Major curvature	Mesocolic adhesion		18 years
5	Billroth II	Pylorus	0	Adenocarcinoma	17 years
6	Billroth II	Pylorus	Glands (nature ?)	Cancer	16 years
7	Billroth II	Minor curvature	0	Adenocarcinoma	15 years
8	Billroth II	Pylorus	0	Cancer	15 years
9	Kocher	Posterior wall	0	Medullary carc.	14 years
10	Billroth II	Entire canalis	Glands (nature ?)	Adenocarcinoma	13 years
11	Billroth II	Min. curv. at pyl.	Glands (nature ?)		10 years
12	Billroth II	Pylorus	Glands (nature ?)		10 years
13	Polya	Entire min. curv.	0	Adenocarcinoma	9 years
14	Polya	Entire min. curv.	Glands (nature ?)	Adenocarcinoma	8 years
15	Polya	Min. curv. at pyl.	Glands (nature ?)	Cancer	8 years
16	Billroth II	Entire canalis	0		7 years
17	Polya	Pylorus	Glands (nature ?)	Carcinomat. ulcer	7 years
18	Billroth II	Entire canalis	Liver adhesion	Adenocarcinoma	6 years

In 17 Cases the Patient Has Been Found to be Quite Well Seven to Twenty Years After Operation.—In one case (No. 18) the question must, for the present, remain undecided (see below).

In all the cases except 4 (Nos. 1, 2, 4, and 11), the clinical post-investigation has been completed by means of X-ray examinations of the stomach.†

In the 12 cases where the diagnosis "cancer" was verified by anatomo-pathological

† I must express my warmest thanks to Professor Forssell and his assistants for the extraordinarily great help they have been to me in the Röntgen post-examinations of the operated cases of cancer.

examination, there are several different kinds of cancer represented, but scirrhous carcinoma.

Among those cases free from relapse, and now living, 10 are men and 7 women. Two of them at the time of operation were sixty-five years old, the others between thirty-six and fifty-six.

Below there are given some brief casebook extracts for the 17 patients who survive and are healthy; the numbers refer to the preceding table:

1. I. 300/1906. Female, thirty-nine years of age. Symptoms for two months previously. Palpable tumor. Operation 23/4 (Landström): *Billroth II.*—Cancer as large as an open hand, on the posterior wall of the stomach, with crater-shaped bottom. Regional lymphatic glands in the curvatures. Adhesions to transverse mesocolon, a part of which had to be excised. Patient lives, quite well, November, 1926.

2. II. 681/1907. Male, forty-seven years of age. Symptoms for eight months previously. Palpable, movable tumor. Considerable retention. Operation 26/9 (Akerman): *Billroth II.*—Tumor as large as a plum in the major side of pylorus. Glands as large as beans in the curvatures. Histological diagnosis: Cancer. Patient lives, quite well, December, 1926.

3. II. 483/1908. Female, fifty-three years of age. Taken ill nine months previously with diarrhœa. Palpable tumor. Operation 29/7 (Key): *Rissler (Polya).*—Movable cancer, as large as a hen's egg, in pylorus with knots in serosa. Small, *hard glands* in the minor curvature, far up toward cardia, *partly left.* Patient living, quite well, November, 1926. X-ray examination 9/11: Of the stomach there remain fornix and upper part of corpus. The stomach evacuates itself best when the patient is lying on her back, but also to some extent in a standing position. No visible form defect, pointing to tumor (Fig. 6).

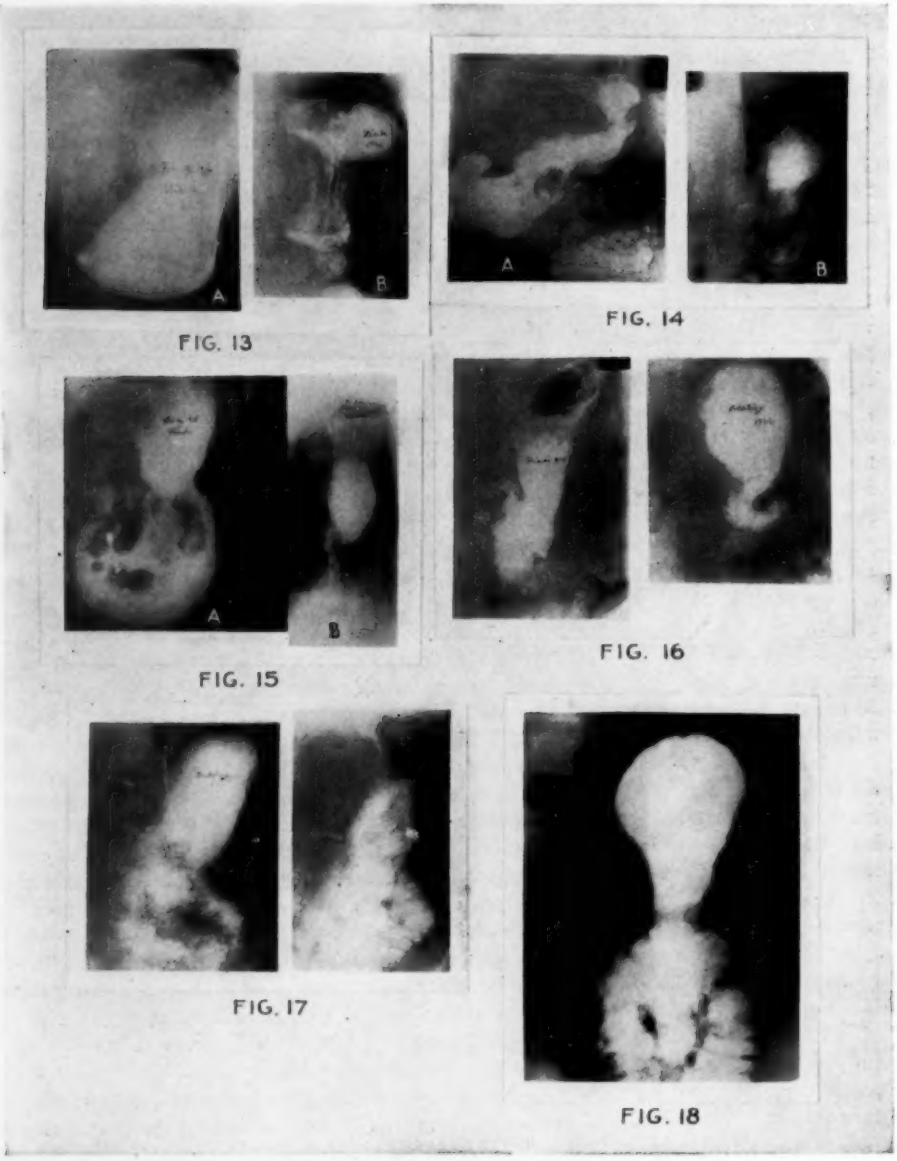
4. I. 592/1908. Male, forty-five years of age. Symptoms for five months previously. Palpable tumor. Operation 14/8 (Berg): *Billroth II + Colic Resection.*—Large tumor at major curvature and going on to mesocolon and colon. No metastases. The patient is living, quite well, November, 1926. A hardness of the bowels compels him to constantly make use of laxative.

5. I. 14/1909. Male, thirty-six years of age. For five years previously gastric ulcer-like symptoms. About one year previously, grew worse. No palpable tumor. Considerable retention. Free hydrochloric acid. Total acidity 90. Operation 9/1 (Berg): *Billroth II.*—Pylorus tumor almost the size of a hen's egg. Regional lymphatic glands. Histological diagnosis: Adenocarcinoma; no metastases in glands. Patient is alive, quite well, October, 1926. X-ray examination 11/10: The remaining part of stomach presents soft and even contours. Peristaltic action ordinary. The stomach empties itself through gastro-enterostomy, which seemed to be situated within canalis; action very bad in recumbent position, but somewhat better in standing one. Still, there exists a moderate retention after four hours. No sign of tumor infiltration (Fig. 7).

6. I. 606/1910. Male, fifty-six years of age. Symptoms for eleven months previously. Palpable tumor. Little retention. Free hydrochloric acid. Total acidity 55. Operation 17/8 (Aleman): *Billroth II.*—Tumor as large as a plum, in minor side of pylorus, with ulcus crater. A few small lymphatic glands in omentum minus. Histological diagnosis: Cancer. Patient is living, quite well, October, 1926. Capacity of stomach 1000 c.cm. No retention. No hydrochloric acid. X-ray examination 3/10: Of the stomach there remain fornix and corpus. The stomach everywhere represents soft and even contours. Peristaltic action ordinary. The stomach empties itself rapidly in both standing and prone position. No sign of tumor (Fig. 8).

7. I. 23/1911. Male, fifty-three years of age. Symptoms for three months previously. No palpable tumor. Operation 7/1 (Berg): *Billroth II.*—Tumor as large as a fist, starting with rounded stem of 3 cm. diameter, from minor curvature, freely

ingrowing with a fungus top-like, expanded part, 5 cm. diameter, and 5 cm. in height, in the stomach. Histological diagnosis: Adenocarcinoma. Patient is alive, quite well, October, 1926. X-ray examination 3/10. Of the stomach there remain fornix and an



FIGS. 13–18.—Skiagrams from cases 12–17 (Sub. IVd). A. Signed before operation. All others at post investigation.

unimportant part of corpus. The stomach presents soft and even contours; and empties itself rapidly, both in standing and prostrate position. Peristaltic action ordinary. No sign of tumor (Fig. 9).

8. I. 249/1911. Male, fifty-four years of age. Mother died of mammary cancer.

Symptoms for seven months previously. No palpable tumor. Retention. Operation 27/3 (Lidén): *Billroth II.*—Cancer in pylorus as large as a hen's egg. Small glands in the curvatures. Histological diagnosis: Cancer. The patient is living, in good health, October, 1926. Capacity of stomach 1400 c.cm. No retention. No hydrochloric acid. X-ray examination 3/10: Of the stomach there remain fornix and corpus. The stomach evacuates itself rapidly in both standing and prostrate position. It presents soft and even contours. Peristaltic action ordinary. No sign of tumor (Fig. 10).

9. I. 341/1912. Female, fifty-five years of age. Mother died of cancer. Symptoms for four months previously. Tumor not palpable. No retention. Operation 13/4 (Waldenström): *Kocher.*—On the posterior wall of stomach, 7 cm. from pylorus a little infiltration, with a crater-shaped ulceration, 1½ cm. in diameter. Some small lymphatic glands in minor curvature. Small resection. Lower resection scission 2 cm. cardially with respect to pylorus. Histological diagnosis: Medullary carcinoma, June 6, 1912: In consequence of stenosis there was arranged an *anterior gastro-enterostomy* and *entero-anastomosis.* The patient is living, perfectly well, October, 1926. No retention. No hydrochloric acid. X-ray examination. Of the stomach there remain fornix, corpus, sinus and the proximal part of canalis. The stomach empties itself relatively slowly. After four hours inconsiderable retention. The stomach presents even and soft contours. Peristaltic action ordinary. No sign of tumor (Fig. 11).

10. I. 422/1913. Male, forty-one years of age. Mother died of gastric cancer. A brother suffers from cancer of rectum. Symptoms for two years previously. Palpable tumor. Retention. Free hydrochloric acid 15. Total acidity 60. X-ray (Fig. 12A). Filling defect in canalis, with ragged edge to right. After four hours, almost complete retention. Operation 24/4 (Troell): *Billroth II.*—Circular tumor, as large as a hand-palm, bound up with pancreas, occupying the whole of pars canalis. In the gastrocolic ligament, several lymphatic glands reaching to transverse colon. The tumor occupies more than one-third of the stomach. Histological diagnosis: Adenocarcinoma. The patient is still alive and quite well, October, 1926. No retention. No hydrochloric acid. X-ray examination: Of the stomach there remain fornix and the upper part of corpus. The stomach empties itself rapidly, especially in standing position. Peristaltic action ordinary. Soft and even contours everywhere. No signs of tumor (Fig. 12B).

11. I. 230/1916. Male, fifty years of age. Mother died of gastric cancer. Symptoms for fifteen months previously. No palpable tumor. Retention. X-ray examination: Tumor, embracing most of the transverse part of stomach. Great retention after four hours. Operation 29/2 (Berg): *Billroth II.*—Cancer, embracing chiefly pylorus and antrum at minor curvature for a space of some cm. Some swollen lymphatic glands along the curvatures. The patient is still alive and quite well, October, 1926.

12. I. 444/1916. Female, forty years of age. Father died of gastric cancer. Symptoms for one year previously. Palpable, movable tumor. Retention. X-ray examination (Fig. 13A): Considerably enlarged stomach, with filling defect within the pylorus region. Great retention after four hours. Operation 21/4 (Flodérus): *Billroth II.*—Movable tumor as large as an apple in pylorus. Enlarged lymphatic glands in gastro-hepatic and gastrocolic oments. The patient is still living, quite healthy, October, 1926. The capacity of stomach 1000 c.cm. X-ray examination (Fig. 13B): Of the stomach there remain fornix and the upper half of corpus. Soft and even contours everywhere. Peristaltic action ordinary. The stomach evacuates itself rapidly, both in standing and a ventral position. No sign of tumor.

13. I. 753/1917. Male, Sixty-five years of age. Symptoms for five months previously, aching in right side of back, at the twelfth rib. No vomiting or dyspeptic trouble. Emaciation. No palpable tumor. Retention. No hydrochloric acid. Weber's test positive several times. X-ray examination (Fig. 14A): Filling defect reaching up to the neighborhood of cardia. Diagnosis: Corpus cancer, extending up along minor curvature to the cardia tract. Operation 10/8 (Troell): *Polya.*—Large tumor extending along minor curvature and the anterior and posterior walls of stomach. It extends

from the neighborhood of cardia 12 cm. downward to 5 cm. from pylorus. A couple of lymphatic glands, as large as a pea, in the gastrocolic oment. In the removed specimen, the tumor goes on the posterior wall quite close to the upper resection margin. Histological diagnosis: Adenocarcinoma. The patient is still living and quite well, October, 1926. No hydrochloric acid. X-ray examination (Fig. 14B): Of the stomach there remain fornix and an unimportant part of corpus. Soft and even contours everywhere. Peristaltic action ordinary. The stomach empties itself rapidly. No sign of tumor.

14. II. 31/1918. Female, forty-four years of age. Symptoms for one year back. Palpable, movable tumor. No retention. X-ray examination (Fig. 15A): Large tumor defect creating an indrawing of the stomach contour, starting from minor curvature within the space from just below cardia to pylorus. Average great retention after four hours. Operation 16/1 (Bohmansson): *Polya. Subtotal Gastrectomy.*—The stomach filled with a tumor starting from minor curvature, which leaves only a small part of corpus nearest cardia free. In the gastrocolic oment a row of lymphatic glands, up to the size of a bean. Histological diagnosis: Very cell-rich adenocarcinoma. No cancer in the glands. The patient is still living and quite well, October, 1926. X-ray examination (Fig. 15B): Of the stomach there remain only fornix and upper part of corpus. The stomach everywhere presents even and soft contours. Peristaltic action ordinary. Rapid evacuation. No sign of tumor.

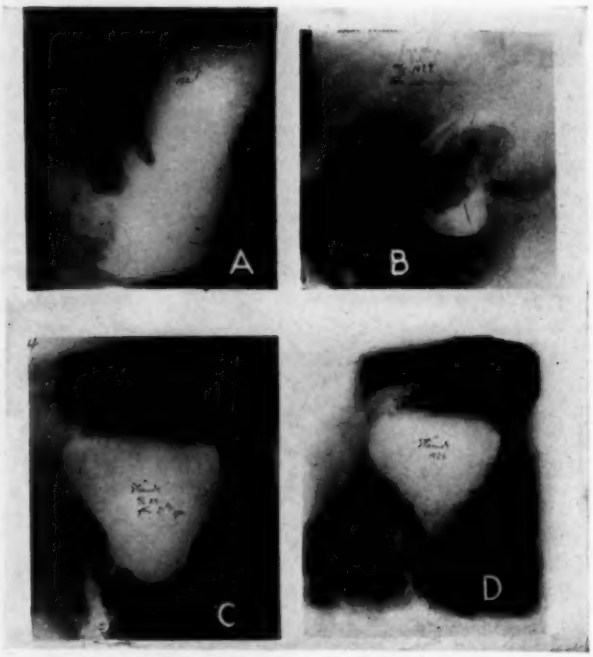


FIG. 19.—Skiagrams from case 18 (Sub. IVd). A. Before 1st resection; B. Before 2nd resection (relapse); C. After 2nd resection; D. At post-investigation.

15. II. 921/1918. Female, sixty-five years of age. Symptoms for one-half year back. Palpable tumor. Great retention. Free hydrochloric acid 42. Total acidity 76. X-ray examination: Antiperistalsis. Filling defect in canalis, nearest pylorus. Great retention after four hours. Operation 5/6 (Troell): *Polya.*—Tumor, as large as a hen's egg in the pyloric part, circular, with the greatest extension in minor curvature. In the gastrohepatic oment a couple of enlarged, soft lymphatic glands. Histological diagnosis: Cancer. The patient lives, in good health, October, 1926. X-ray examination (Fig. 16): The stomach presents everywhere soft and even contours. No remains after four hours. No sign of tumor.

16. I. 257/1919. Male, fifty-five years of age. Father died of gastric cancer. Symptoms for one year previously. Palpable, movable tumor. No retention. Operation 14/3 (Ekehorn): *Billroth II.*—Circular cancer, beginning at pylorus and extending about 10 cm. upwards, ulcerated. The patient is alive, quite well, October, 1926. Capacity of stomach 1000 c.cm. No retention. No free hydrochloric acid. X-ray examination (Fig. 17): Of the stomach there remain fornix and corpus. The stomach presents even and soft contours. Normal peristalsis. Rapid evacuation. No sign of tumor.

17. I. 527/1920. Female, forty years of age. Ulcus trouble for nine years back. During last year, worse, with increasing pains in the epigastrium, acid eructations, emaciation. No palpable tumor. Inconsiderable retention. X-ray examination: Here there exists an alteration in the terminal part of canalis close to pylorus, with infiltration in the wall. Whether this is caused by an ulcer or a tumor it is impossible to decide with certainty. After four hours, fairly great retention. Operation 27/5 (Troell): *Polya.*— Infiltration, as large as a thumb, in minor curvature, immediately proximate to pylorus, with ulcus crater. At major curvature some non-malignant lymphatic glands, as large as almonds. Resection 6–7 cm. long. The crater 2 x ½ cm., goes deep into the muscular wall at minor curvature. Histological diagnosis: Carcinomatous ulcer. The patient is still alive, quite well, February, 1927. No retention. Capacity of stomach 500 c.cm. No free hydrochloric acid. X-ray examination (Fig. 18): Of the stomach there remain fornix and corpus. At the bottom of the resected stomach there lies the gastro-enterostomy opening. The remaining part of stomach presents even, soft contours. No sign of tumor. Rapid emptying.

If we examine the operative records, it is found that certainly it is not all the cases that have been technically simple pylorus tumors, or tumors situated in the neighborhood of pylorus. Cases 1, 4, 10, 13 and 14 present instances of large and extensive gastric cancers, which, with a good result, have been removed by means of resection.

It is, therefore, very striking, that, among the relapse-free cases, there are several which, on operation, have been fairly advanced cases, while, among the late relapses, there is scarcely anything else than pylorus tumors (really, with but one exception). This circumstance is, however, not so very strange as would appear at first sight. If one succeeds, in the operation of a relatively advanced case, in really removing all cancer tissue which microscopically infiltrates the stomach wall round the outside of the tumor, then there is no relapse (provided that there exists no remote metastasis). If one, on the other side, does not succeed, a relapse occurs. But, in advanced cases this, most probably, will occur soon, and, consequently, will not be a late relapse.

In 7 of the 8 cases that were tested in this respect, achylia has been found. In case No. 5 there was discovered free hydrochloric acid 13, and total acidity 40. In this instance, there had been found before operation a hydrochloric acidity 90. (Histological diagnosis: Adenocarcinoma.)

In all the cases examined, there was found a good motility, and clinical retention was absent. The capacity of the stomach has varied between 500 and 1400 c.cm.

In the 13 cases examined by Röntgen, the result of the examination was satisfactory; in several cases there was a rapid emptying of the stomach, usually mostly in a standing position. The wall of the stomach has presented even and soft contours, with ordinary peristalsis. No signs of tumor infiltration.

Most of the patients present normal evacuation. One patient (No. 4) complains, however, of stubborn hardness of the bowels, which compels him to constantly employ some laxative. Another (No. 15) has to eat some apples every day of the same cause. Five patients (Nos. 5, 11, 15–17) state that, on a few occasions, they suffer from a transient diarrhœa; otherwise their evacuations are normal.

Case No. 18 in the preceding table is almost unique, for *the patient, on two occasions, at an interval of three years, has been submitted to resection for gastric cancer,* and at present, three years after the last operation, is clini-

cally and röntgenologically relapse-free. A brief account of this case is given here:

I. 25/1921. Male, forty-six years of age. Father died of cancer, three years before admission; there had been for some months symptoms of gastric ulcer. Three and a half months before admission loss of appetite, eructations, and emaciation, with palpable tumor. X-ray examination (Fig. 19A): Large tumor defect in canalis, beginning 3 cm. distance from angulus, and extending to the vicinity of pylorus, most pronounced on the major side, where there is seen a rounded indrawing, with stiff, ragged contours. No retention after four hours. Operation 10/1 (Ekehorn): *Billroth II*, with *anterior gastro-enterostomy and entero-anastomosis.*—Circular cancer occupying pars pylorica from and inclusive of the pylorus itself, 10 cm. long in minor curvature, and 15 cm. in major. Adhesions to liver, gall-bladder and the other surrounding parts. The entire transverse part of the stomach was removed. The greater part of the surface of the tumor was ulcerated. The ulceration surrounded by a high wall. Anatomo-pathological diagnosis: Adenocarcinoma. Discharged cured.

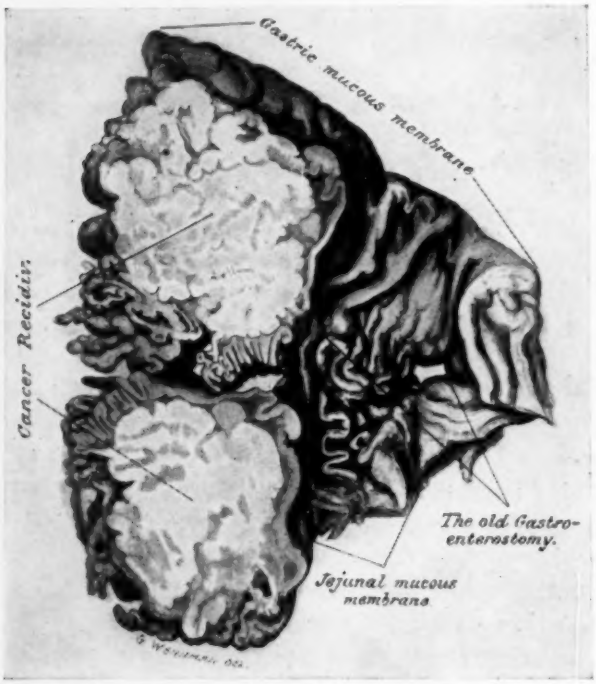


FIG. 20.—Relapse of cancer of the stomach; drawn from a specimen removed by a second operation (atypical resection), three years after the first.

The patient afterward remained subjectively well until March, 1924, when he began to be troubled by eructations and vomitings within one-half hour after food, pains in the epigastrium, emaciation and lassitude. Readmitted 19/5, 1924. Retention. Achylia. Capacity of stomach 1800 c.cm. Weber's test in fæces positive. X-ray examination (Fig. 19B): Of the stomach there remain only fornix and corpus. The contrast empties itself at a fairly slow rate through the gastro-enterostomy. At this place there is visible a defect in the contrast, as large as a good-sized mandarin-orange. The contours of the defect are sharp and stiff. Diagnosis: Malignant infiltration. Operation 21/5 (Troell): *Atypical resection* of stomach and jejunum, with *antecolic, terminolateral gastro-enterostomy.*—From the upper angle of the gastro-enterostomy there extended upward into the wall of the stomach and the gastrocolic oment, a knotty cancer, as large as an apple, with adhesions to pancreas. The gastro-enterostomy was removed entirely. The loops of jejunum were divided below the gastro-enterostomy, and were anastomosed end to end. In the removed specimen (Fig. 20) the gastric wall is seen to be free, with the exception of a place to the right in the minor curvature, where a part of harder consistency, spreads like a sponge over the surrounding parts. Histological diagnosis; Adenocarcinoma. X-ray examination, three weeks after operation (Fig. 19C): Gastro-enterostomy opening fairly narrow or, possibly, somewhat contracted. In prostrate position slight evacuation of stomach; quicker in standing position. After four hours great remains in stomach. Discharged 13/6.

31/3, 1926: Good general condition. No palpable tumor. Weber's test negative. No retention. No free hydrochloric acid. Total acidity 10. X-ray examination 3/4 (Fig. 19D): Of the stomach are seen to remain only fornix and upper part of corpus. The gastro-enterostomy has a width of about 1 cm. Slow evacuation in prone position, quick in a standing one. The stomach exhibits even contours. Ordinary peristalsis. After four hours no retention. No visible form defects that point to a tumor relapse.

April, 1927: The patient is still living, and, subjectively, is quite well.

In this case, consequently, nothing can yet be said as to the future prospects of the patient. Judging by the röntgenologically shown freedom from relapse, two years after the last resection, taken together with the absence of subjective trouble three years after the last operation, they may be supposed to be not very dark, however.

V. METHODS OF OPERATION AND LATE RESULTS

From the table on page 331 there will be seen that 203 patients survived the operation, out of 269 who had been operated on before 1922. Of these, 3 were not found. The following table shows the various methods of operation employed, and also the time within which the relapse has occurred in the different cases:

Resection	Number	Number of lapses occurring the												No relapse
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	11th	15th	17th year	
Transverse—Kocher and Billroth I.....	17	4	6	4		1								2
Billroth II and Polya.....	183	61	55	18	9	4	3	2	3	1	1	1	1	24

To the *upper group* there belong technically relatively simple cases where the cancer was situated in, or close to, pylorus, and has been of very little size, and, in addition, 3 cases (transverse resection), where the tumor was localized to canalis. They also belong, with the exception of the 3 cases of transverse resection, to the earliest in the material.

Two cases are relapse-free fourteen years after operation; 14 have died within the space of three years, and another within five years after operation. It is, consequently, remarkable that *not a single patient who was operated on according to Billroth I, or other methods comparable with this, belongs to the cases of late relapse.*

To the *lower group* belong the cases of all degrees of difficulty, among them 8 where, simultaneously, colon resection was necessary.

Twenty-four cases have been relapse-free six to twenty years after operation. One hundred and thirty-four have died of relapse within five years. *In addition, 12 more have died of relapse within a period of from five years and four months to seventeen years after operation.*

The number of surviving cases operated on according to Billroth I and similar methods, is, unfortunately, too little to allow of a percentage comparison with Billroth II and Polya, as regards the frequency of relapse-free cases. But to judge by the many cases of late relapse *Billroth II and Polya have, in our material at least, proved themselves absolutely superior to Billroth I and similar methods, as palliative operations.*

This, as a matter of fact, is by no means astonishing, when we consider the tendency cancer of the stomach has to spread in the mucous membrane and submucosa, in fine, microscopical streaks, in many instances far beyond the macroscopic limits of the tumor.[3] It is a matter of course that the operator, in Billroth II and its modification Polya, can more easily determine to remove a very large part of the stomach than is the case in Billroth I, where one is obliged, at any cost, to avoid that tension on the sutures which would expose the immediate results to very great risks.

It is possible that, by extended mobilization of the duodenum, it will be possible, by means of Billroth I, to successfully carry out very extensive resections too, but I take it as a matter of course, that *Billroth I, Kocher and transverse resections are operations which should always be avoided in the surgical treatment of cancer of the stomach.*

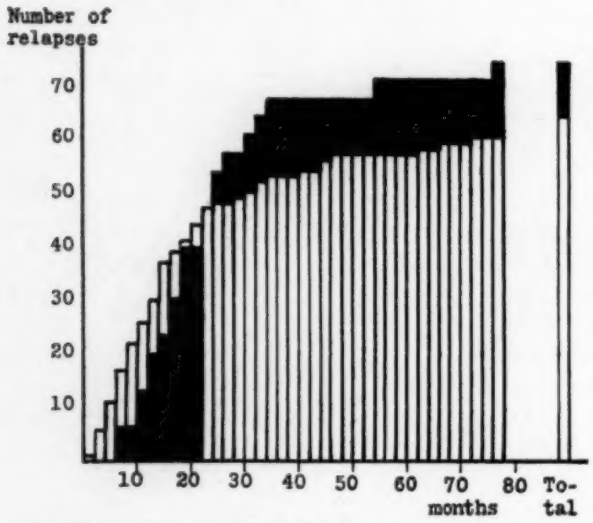


FIG. 21.—Each column stands, in horizontal direction, for a space of two months. From the operation, which is supposed as being placed in *origo*, to the last column in the series drawn, there has, consequently, elapsed a space of six and one-half years. The tops of white columns show the absolute number of relapses after resection for adenocarcinoma, etc.; that of the black ones, the number of relapses after resection for scirrhous tumors, after reduction from twenty-two to seventy-four in order to obtain a better comparison.

We have seen above that the immediate risks, too, in Billroth I have proved to be greater, or just as great as in Billroth II and Polya.

VI. CANCER TYPES AND LATE RESULTS

It has gradually become an axiom that the fibrous forms of cancer of the stomach are more benign than other forms. Kausch[4] says in this respect: " . . . die fibrösen Formen scheinen nach der Radikaloperation weniger leicht zu rezidivieren und weniger zu metastasieren."

If we examine our material in this regard, we shall find that this is not at all the case.

Of the cases surviving the operation, where the operation took place more than five years back, and of which we possess a detailed histological special diagnosis, 22 are scirrhous carcinomas, and 74 of other types, cancer medullare et simplex, cancer gelatinosum et colloides, and adenocarcinoma.

Not one of the 22 scirrhous cases has been relapse-free, while among the 74 cases of adenocarcinoma, etc., 10 (13.9 per cent.) have escaped a relapse.

On the other hand, it has undoubtedly been the case that the scirrhous tumors have relapsed more slowly than the other cases.

Of the 22 relapses which followed the resection of scirrhous cancer, none has resulted in death within the first one-half year, and only 4 within the first year. Of 64 relapses after adenocarcinoma, etc., 11 patients have died within the six months and 26 within one year.

The diagram in Fig. 21 is intended to illustrate the tendency to relapse which has been shown in this material, in the case of scirrhous tumors, on the one hand, and of adenocarcinoma, etc., on the other.

It is shown immediately by the diagram that, during the first two years after operation, the tendency to relapse, in the case of adenocarcinoma, etc., proved to be considerably greater than in that of scirrhous tumors. At the beginning of the third year, this condition of things began to change, and from that point the number of relapses rises for the latter class more rapidly than for the one first mentioned.

The single cloumn shows graphically the higher, total tendency to relapse in the case of scirrhous tumors. Expressed in per cent., the relapses in the case of scirrhous tumors, as compared with those in other classes, have been as 100 : 86.1.

Although *scirrhous carcinoma* ought, undoubtedly, to be of a *biologically more benign character* than other cancers of the stomach, it has, in our material proved itself, *practically speaking, more malignant.*

Possibly, the explanation is to be sought for in the fairly customary disposition of scirrhous tumors to show symptoms at a late period. The diagnosis is frequently not made until the tumor has spread to great dimensions in the wall of the stomach. Microscopically, too, the tumor infiltration, in most instances, often extends beyond the palpable limits of the tumor; in many instances to a fairly great degree. If microscopic rests of cancer happen to be left on resection, then relapse occurs, but this appears at a somewhat late date, just in consequence of the special biological features of scirrhous.

It should, then, in the case of scirrhous tumors, too, be of extreme importance to remove a large part of the stomach, far beyond the macroscopic limits of the tumor.

VII. SUMMARY AND CONCLUSION

This investigation is based on a material of 1150 cases of gastric cancer which were operated on at the Seraphimer Hospital during the period 1887–1926.

Cancer cardiæ is not included.

Three hundred and sixty-one cases were resections; their operative mortality was 28 per cent.

Four hundred and fifty cases of gastro-enterostomy; operative mortality 23.1 per cent.

Three hundred and thirty-nine exploratory operations; operative mortality 17.1 per cent.

Resection has been performed on 210 men (operative mortality 32.9 per cent.) and 151 women (operative mortality 21.2 per cent.). Thus, considerably higher mortality in men.

During the last two and one-half decades, the operative mortality has exhibited an evident increase; from 20 per cent. (1902–1906) to 38 per cent. (1922–1926).

The causes of this are: (a) Extended indications for resection, and (b) a great displacement of the material from feminine to masculine majority (Fig. 4).

An evident parallelism is shown between the operative mortality and the number of resections in per cent. of the total number of verified cancer cases in different time periods. The number of technically easy cases has been steadily decreasing (see table on page 325).

In 19 cases (all, excepting 4, belonging to the last fifteen years), it has been necessary to perform, simultaneously, colon resection. Eight (42 per cent.) died in connection with the operation.

Seventy-one patients, or 19.6 per cent. of the total number operated, have died of abdominal complications; 18 (5 per cent.) of pulmonary, 12 of which pneumonias in patients, except one, above sixty years of age. In addition, 12 patients died of complications of a more accidental character.

Of 71 abdominal complications, 1 was intra-abdominal bleeding, 2 necrosis of pancreas, 42 diffuse, and 16 circumscribed peritonitis, 7 cases of ileus and, finally, 3 postoperative fistulas, with marasmus. Suture insufficiency was proved in 23 cases.

Billroth I and Polya have contributed a considerably worse immediate operation result than Billroth II.

On examining the durability of the results, respect has only been paid to cases which had been operated on more than five years ago. Two hundred and sixty-nine cases operated on; 66 died primarily; 3 not found.

Of *200 surviving cases, there died within five years 161* (80.5 per cent.), viz., 61 the first year, 61 the second, 26 the third, 9 the fourth, and finally 4 the fifth year. All these except 2, most certainly died of a relapse.

In addition, 12 patients died of a relapse later than five years after operation. In all these cases, except one, the cancer was localized to pylorus, or its immediate neighborhood. In one instance, the tumor was situated in major curvature and mesocolon. Only in one instance did there exist cancer regionally in the lymphatic glands. In all these cases of late relapses, had the patient been subjectively well until a few months before death. The patients lived from five years and four months to seventeen years after operation. None of these patients was operated on according to Billroth I.

Further, 9 patients have died of some other disease later than five years after operation. The causes of death in all the cases has been stated by medical men, in 6 of the instances at the hospital where the patient died. One or two of these cases seem to me, nevertheless, suspect to have been cancer relapses, too.

Eighteen patients are still living, 17 of them well, seven to twenty years after operation. One patient operated according to Kocher, all the others according to Billroth II and Polya. Several of the tumors were large, one of them going on to the transverse colon, which also had to be resected. One tumor was 12 cm. long, and extended up to the vicinity of cardia. Subtotal gastrectomy had to be performed. In none of these 18 cases had cancer been proved in the regional lymphatic glands removed. In all the cases except 4, the clinical post-examination could be supplemented by X-ray examination.

It is remarkable that, among the relapse-free cases, there are several rather advanced ones, while, among the late relapses, there were found scarcely anything else than moderately advanced pylorus tumors.

One patient has, on two occasions, been subjected to resection, at an interval of three years. He is still alive, and is subjectively and objectively well, almost three years after the last operation.

From the point of view of the durability of the results, Billroth II and Polya have shown themselves to be absolutely superior to Billroth I, transverse resection and Kocher.

Scirrhous tumors have proved to show a greater relapse tendency than the other forms of gastric cancer. None of those surviving the operation for scirrhous tumor, have remained relapse-free, while, of the other cases, 13.9 per cent. have not had a relapse.

In June, 1890, Th. Billroth and his assistants [2] had already performed 29 pylorus resections for carcinoma, with 16 primary deaths. Billroth says at the close of his lecture at the International Congress in Berlin, 1890:

" . . . ist doch wiederholt gegen diese Operationen wegen Carcinom geltend gemacht, dass bisher noch kein Fall von radikaler Heilung eines Magen- oder Darmkrebses durch die Resektion vorliege (nur eine Frau überlebte die Pylorus-resektion wegen Carcinom 5¼ Jahre), und dass der Wert solcher Operationen beim Carcinom daher sehr problematisch sei; dass auch in den meisten Fällen die Diagnose erst dann sicher zu stellen sei, wenn der Fall nicht mehr mit Aussicht auf Erfolg operiert werden könne. . . . Wer aber das Aufblühen solcher Kranken nach Beseitigung der Pylorus- und Darmstenosen durch Carcinom erlebt hat, wird nicht daran zweifeln, dass diese Patienten den Theil des Lebens, welcher ihnen überhaupt noch vom Fatum bestimmt ist, in weit angenehmerem, erträglicherem Zustande verleben als wenn sie nicht operiert wären. Auch in dieser Beziehung nehmen also diese Carcinomoperationen keine Sonderstellung ein. Der Unterschied liegt bisher nur in der *Schwierigkeit der frühen Diagnose und in der Gefahr des operativen Eingriffes.*—Ich hoffe, dass beide Momente keine unheilbare Gebrechen unserer Kunst bleiben werden. Ich zweifle nicht daran, dass bei fortgesetztem eifrigem Studium eine frühere Präcisirung der Diagnose möglich werden wird, und dass wir die Gefahren dieser Operation durch Vervollkomnung der Methoden und der Technik um ein Bedeutendes zu verringern im Stande sein werden . . ."

Has the prophecy of the great precursor been fulfilled? Yes, undoubtedly, to a not unimportant degree. Many are the statistics who have shown a five years' freedom from relapse amounting to 20 per cent. and thereabouts, of the surviving cases operated. But, as the greater number of the cases of gastric cancer cannot at all be subjected to resection, and as, in addition, the majority of the resected cases die in connection with the operation, or from a relapse during the years immediately succeeding the operation, we are as yet unable to say that resection of stomach has very emphatically proved to be an ideal weapon in the combat against gastric cancer. Many are they who, following Billroth, have pointed out the importance of an earlier diagnosis. Great, too, is the number of those who have clearly seen and pointed out the limits for the possibilities of an early diagnosis, viz., the, in many instances, lingering course of cancer of the stomach, and its long period of latency. Röntgen examinations have extended our diagnostic possibilities in an unheard-of degree, but, just by doing so, they have also increased our operative indications to cases which are even more difficult, technically. And it is just for this reason that the decrease in primary mortality, which Billroth hoped for, have not, as yet, by far, from a percentage point of view, been attained. But it is certain that a more extensive employment of the operative treatment of cancer of the stomach has been the result. *And in this way, most certainly, the improved diagnostics, hand in hand with the also improved technics, have tended to an increase in the number of those who have to thank a successful operation for their lives.* Nor ought we to forget those who have had their existence prolonged by a few or many years of good health. As we have seen above, the number of these patients is much greater than that of those radically cured.

But mankind awaits with impatience a better remedy against cancer, cancer of the stomach included, than the knife of the surgeon.

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THE COLLOIDAL LEAD TREATMENT OF MALIGNANT NEOPLASMS*

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There is little in the literature to confirm the results obtained by Blair Bell from the intravenous injections of colloidal lead in the treatment of malignant neoplasms. His theory, also, regarding the selective action of lead upon trophoblastic cells and hence of tumor tissues in general, although it has been a subject for research among numerous workers, remains to be proved. It is unfortunate that his emphasis upon the danger of the clinical application of his method has not been accompanied by fuller details of the making of his preparation and its administration, and by a more complete description and analysis of the toxic effects and clinical results. Wood has done much in this country to interpret Blair Bell's theories, but his own experimental work on animals has tended to disprove the conception of the selective action of lead upon tumors. Martland's work, also, from the treatment of 15 patients, appears to disprove this theory. Using, apparently, a very stable preparation of colloidal lead, he was able to inject very large amounts without producing any serious immediate toxicity. Subsequently, however, serious lead poisoning resulted, and from the autopsies in 8 cases, the lead was found in large amounts in the liver, bone-marrow and, especially in the spleen, which contained twenty times more than the primary tumors and forty times more than was found in the metastases. Also, whenever traces of lead were found in the tumor, it was always in the " histiocytes " of the stroma and not in the tumor cells. Martland interpreted his findings to mean that the particles of lead were retained in the body by being picked up in the reticulo-endothelial system and later, after large amounts had been injected, the lead began to be paid out slowly in a toxic form into the circulation. He obtained apparently, no favorable clinical results, and they would hardly be expected from the type of tumor selected in some of his cases and from the advanced stage of the anæmia and cachexia which existed in others. The literature contains a considerable amount of discussion of the effects of lead poisoning upon the gestations products in both animals and the human subject (Paul, Hanzlik, Oui). Dilling states that lead has a definite non-specific action on growth, like other metals, and that there is evidence of lead having

* This work was carried on in the Memorial Hospital of New York. The preparation of the lead was made in the chemical laboratory by Dr. H. Q. Woodward. The blood and urinary examinations were made in the Pathological Laboratory under the direction of Mr. E. C. Ellis. Clinical assistance was given by Dr. Max Cutler, Dr. J. W. Spies, and Dr. H. Copeland.

greater power than other metals of inhibition on the germination of cells, or of retarding the growth of embryonic tissues in strength not toxic to more mature tissues. There is nothing, however, to verify, specifically, Blair Bell's conception. Eising, in an editorial review, suggested that, possibly, the metallic colloids, having an intense affinity for oxygen, may act through this affinity and establish a local starvation of the tumor cell. Wood has given a brief résumé of the work that has been done with other metals. Notable among these workers was Weil, whose work at the Memorial Hospital with copper produced entirely negative results. Ochsner appears to have observed some favorable clinical results from colloidal gold, but this judgment seems to be based largely upon reports from the patients, their relatives, or local physicians. Such a method, however, does not furnish a basis for scientific study, but it has always been popular, especially among those exploiting so-called cancer cures. In regard to the use of lead as a constitutional remedy, it is of interest to find that its efficacy as a local agent was first proposed by Goulard in France in 1750, who based the evidence of its value upon the reports of a few cases made by the patients themselves, in some of whom there is not sufficient evidence, to show that a malignant growth existed. However, it evidently attracted wide attention, because Goulard's monograph was translated by Armand into English and ran into three editions. It may, also, be evidence of its wide acceptance at that time that the name of "Goulard's Extract" was given to "liquor plumbi subacetatis" in the British Pharmacopœia. A few observations recently made by the present writers suggest that it may have some value as a local application to ulcerating neoplasms. The value of colloidal lead as a constitutional agent is attested by only a few case reports. Coke and Cook, in England, using smaller doses than Blair Bell and a more stable suspension, report a few favorable clinical results. In this country, Wood has evidently observed improvement in a few cases, but he has made no formal report of his results. The case reported by O'Crowley of an epithelioma of the penis, treated by both lead and surgery gives no facts to prove or disprove the value of lead. Also Bulkley's assumption of a "Death from Blair Bell's Colloid Lead Injection" four weeks after the beginning of treatment is not justified by the facts that are reported. It is plain, therefore, that the use of colloidal lead for the treatment of malignant neoplasms is in an experimental stage.

The observations of the present writers have been made at the Memorial Hospital during the past eleven months in the course of treatment of 21 patients with the following lesions: Carcinoma of the breast, 7; malignant bone tumors, 5; carcinoma of the uterus, 3; carcinoma of the rectum, 1; angiosarcoma of the mouth, 1; malignant retroperitoneal tumor (pancreas), 1; metastases of a malignant tumor of the (testicle?), 1.

The selection of cases has been made entirely from the standpoint of the safety of the patient, presuming that some lead toxicity is necessary in order to obtain any favorable clinical results. Excluding, of course, all cases favorable for cure by surgery, and, also, all cases such as lymphosarcoma or the

metastases from teratoid tumors of the testicle, in which radiation is now generally known to produce favorable results, we have limited our cases to those in which the disease is well advanced. Of these, however, we have tried to exclude those apparently in the terminal weeks of the disease, or those in which anæmia, cachexia and the general condition are such that the introduction of a poisonous agent would apparently be a hazardous undertaking. Our attention has been directed to the advice of Blair Bell that cases should be excluded in which the lungs, liver and kidneys are involved by either disease or tumor. Our observations, however, indicate that in the selection of cases such precautions may be prudent, not because these organs have shown any special selectivity for the lead, but because either metastases in these organs may indicate that the disease is too far advanced, or we would expect a poison introduced into the circulation to require a fairly normal state of the liver and kidneys for its proper excretion. It is for these reasons that so far we have not accepted cases having tumors which otherwise we would like to treat, such as gastric cancer, of which no case has yet appeared in which the general condition of the patient has seemed to us to justify the trial of this method. It may be that the field for the use of lead may be widened in those cases in which anemia appears to be the only objection to its use by a more frequent resort to a preliminary transfusion than we have thought it was best to do in this series. We have resorted to this procedure as a preliminary measure in only two cases, in both of which it appeared to be of considerable assistance. If, however, the anemia is combined with a marked cachexia, we doubt its advisability, for we have not yet forgotten the failure of transfusions to meet the situation created by the enthusiastic efforts to apply the so-called massive doses of high voltage X-ray when it was first introduced from Germany. Similar failures will follow the use of lead unless due caution is used in avoiding the treatment of patients in the terminal weeks of the disease.

The dosage of lead, the formula and the intervals of its administration are matters of extreme importance, about which there appears to be at present considerable confusion. Our preparation, which has been made in the chemical laboratory of the Memorial Hospital by Dr. H. Q. Woodward, is as follows: The colloidal lead was prepared by maintaining an electric arc between lead electrodes immersed in a .00022 normal potassium hydroxide solution. The apparatus consists of a 600 Pyrex glass beaker containing the positive and negative electrodes. The positive electrode is a sheet of commercial lead covering the bottom of the beaker and a strip of lead leading up to the top of the beaker. The negative electrode is a roll of C. P. lead foil attached to a screw feed. The beaker is covered with a mica cover perforated to admit the passage of the negative electrode and of a glass tube and a thermometer. The beaker is immersed in an ice bath. A voltmeter is connected in parallel with the arc.

In preparing the colloid, the potassium hydroxide solution is boiled, the beaker is immediately transferred to the bath, and the positive electrode and

mica cover put in place. The thermometer is adjusted below the surface of the solution and the end of the glass tube just above the surface. A stream of air freed from carbon dioxide by washing with strong potassium hydroxide solution is passed through this tube over the surface of the liquid during the entire time the apparatus is in use. Ice is added to the bath containing the beaker until the temperature falls to 20° C. The current is then turned on and the arc established and maintained by manipulating the screw feed of the negative electrode. The rheostats are adjusted so that the current flowing across the arc is 1.4 amps. and the potential drop 40 volts. The temperature during arcing is continued until 1–1.5 g. of lead has disintegrated from the negative electrode per 100 c.c. of sol formed. The positive electrode does not disintegrate appreciably. The colloid is then transferred immediately to 50 c.c. centrifuge tubes and centrifuged for five minutes with a force of 1000 X gravity. Samples are withdrawn for analysis by the colorimetric sulfide method, and the tubes closed at once with an air-tight paraffin seal. Sols so prepared have an average concentration after being centrifuged of .130 lead, with an average deviation from this value of ±11 per cent. These sols have kept for four weeks without coagulation; and sols ranging from two hours to nine days have been used for intravenous injections. These sols differ from those described by Blair Bell in being less concentrated and in containing no gelatine or other protecting agent, except that in the sol prepared for the first injection .4 per cent. of gelatine was used, but thereafter omitted because of the immediate reaction that followed. The sol after being prepared is not sterilized, for the entire procedure is done under aseptic conditions, and it is also itself antiseptic. Numerous specimens so prepared for injections have been tested and found to be sterile. This sol, also, is evidently more stable than that used by Blair Bell and does not require its immediate use. No difference clinically has been observed in our cases whether it was used on the day of preparation or nine days later. We are unable to make further comparisons of this sol with any other because it is the only preparation of lead that we have used. Whether its stability, as compared with Blair Bell's is an advantage beyond the added convenience, it is impossible to state, but the favorable results obtained by Coke and Cook with more stable sol suggest that results may be obtained with a less amount of toxicity than that observed by Blair Bell.

The dosage of lead and its administration can only be discussed from the use of our own preparation. We found that we were unable to follow the suggestion of Blair Bell that to obtain the most favorable results, it was best to inject a total of 600 milligrams within a period of two or three months, using 100 milligrams at each injection if we were to adhere to the principle upon which we began the work of considering the comfort and safety of the patient without regard to the effects produced upon the tumor tissues. Upon this principle, therefore, we first tried to use an amount at each injection which would not produce severe reactions, and then determined the intervals between the injections by the recovery of the patients from the

clinical symptoms, especially anemia, produced by the previous injection. In two cases in which we used 100 milligrams at intervals of seven days, the reaction, although transitory, was more than what we regarded as safe. In adults, therefore, according to their general condition and body weight, we have varied from 50 to 90 milligrams at each injection, not using more than 100 in any case. Our largest total amount in any case has been 375 milligrams extending over a period of four months at varying intervals. The intervals in different cases have varied from five days to four to five months. It may be that we might have shortened the intervals between injections by a more frequent resort to transfusions, for after fifty-six injections this procedure has only been done seven times, and in only one instance because a real emergency arose from the extreme anemia. One patient received three transfusions—a case of chorio-epithelioma, which we were most anxious to treat because of Blair Bell's theory of its probable susceptibility, and, although the fall in the number of red cells after the injections was not extreme, the patient at the beginning had a marked anemia and was bleeding from the vaginal tumor. Ordinarily, we would not have accepted the case for the lead treatment. Regarding the actual amount to be used at each injection, we have calculated that not over 1.5 to 2.0 milligrams of lead, as prepared by our formula, per kilogram of body weight may be regarded as a safe guide and is the amount which has produced the results which we have so far obtained.

The clinical signs of lead toxicity, as observed after fifty-six injections in 21 cases, were severe in four instances, pronounced but not alarming after five injections, and mild, occurring transiently with one or two symptoms in all of the others.

During and immediately following the injections, there was only one reaction which appeared to be alarming, beginning twenty minutes after the completion of the first injection of only 10 milligrams in the first patient treated. It began with a severe chill, followed by a rise of the temperature to 103° F. with a rapid and feeble pulse, cyanosis and a state of complete collapse, but quickly subsided after an intravenous injection of adrenalin. In this first preparation of the sol .4 per cent. of gelatine was used, but has been omitted from all of the subsequent preparations, and no more reactions of that kind have been observed. Subsequently, in the same patient 30 milligrams of lead were injected without the gelatine and no reaction occurred. With this exception, then, there have appeared no serious symptoms during or immediately following the injections. There appears to be little effect upon the quality or rate of the pulse during the time of the injection, which has varied from two to twelve minutes. In twelve instances the pulse rate was accelerated from fear or excitement at the beginning, and in seven cases became less frequent and of better quality at the termination. In fourteen instances there was a slight decrease in the volume, which, however, required no medication except in four. During twenty-one injections toward the finish there were subjective sensations of tingling or burning, especially

about the lips and face. Eight patients noted a metallic taste which in two persisted for several hours. After four injections the patients remarked about some obscure sensations in or about the tumor, in no instance amounting to actual pain. Near the finish of the injection nausea occurred four times—in three of vomiting.

During the First Twenty-four to Thirty-six Hours.—The only three severe reactions from the lead which occurred in this series began within six to fourteen hours after the injection—two having hæmaturia and jaundice, in one of which there was marked swelling of the liver. In one case having severe dyspnœa and prostration with a rapid and feeble pulse, the reaction appeared to be an exacerbation of similar attacks which had occurred prior to the injection, and was due to the terminal period of a pleurisy with effusion from metastases of a carcinoma of the breast, from which she died five weeks later. In the third case, also, having severe dyspnœa and prostration for the chief symptoms, the reaction was associated with a large collection of fluid within the pleural cavity and pulmonary metastases from a carcinoma of the breast. The recovery from the reactions was prompt in all of the cases, except the one having the swollen liver, in which the anemia became so severe within five days that a transfusion was done and was followed by a prompt and satisfactory recovery from all of the symptoms. Sharp reactions occurred in five other cases, characterized by nausea, vomiting, rapid pulse and considerable prostration, which, however, lasted only a few hours except in two cases in which nausea and vomiting persisted for two days. Milder reactions occurred in practically all of the other cases during the first twenty-four hours and lasted a few hours. They were characterized by one or two symptoms—nausea and vomiting, 28; abdominal cramps, 10; dizziness, 5; headache, 4; transient hæmaturia, 2. There was a rise of temperature following twenty-two injections from 99 to 101, which lasted only a few hours except in two cases having markedly infected tumors in which the temperature persisted for several days.

Subsequent Course and Symptoms.—Except for the anemia, a few instances of nausea and vomiting and abdominal cramps and a transient jaundice, the recovery of the patients from the effects of the lead toxicity was rapid and apparently complete. A consideration of the toxic effects upon the individual organs confirms also the temporary nature of the toxic effects.

The Gastro-intestinal Tract.—There was hardly a case which did not have occasional attacks of nausea and vomiting, but there were only two instances in which a prolonged disturbance of this nature occurred, beginning several days after the injections and persisting for two days in each case and without any sign to indicate a special cause. Loss of appetite persisting over a period of two weeks was not uncommon but finally disappeared. Constipation did not appear to be more common than we ordinarily observe in other patients and therefore did not appear to be related to the lead poisoning. Abdominal cramps, or lead colic, was not so frequent a symptom

as it is reported to be in the literature of chronic lead toxicity, but after four injections it was a prominent symptom, and in one case it offered an annoying complication over a period of ten days. In the same patient it reappeared after a subsequent injection, but less severely and for a shorter time. It was not associated with a severe constipation and was relieved by saline catharsis and a higher calcium intake in the food and by the administration of calcium lactate.

The liver did not appear to have been seriously injured, enlarging sufficiently to become palpable in only one case, and disappearing promptly as did the jaundice which occurred in five other cases.

The kidneys also, as determined by the urinary findings, were not affected apparently beyond the state of an acute congestion. The urine was negative before the injections were begun in 15 patients, and in the six whose urine showed a trace of albumen and in the one with casts also, the urinary findings after the injections were no worse than in those in which the urine had been negative. Of the 15 cases showing negative findings prior to the injections, following 40 injections, there were only four which did not show either a trace of albumen alone or both albumen and casts at some period during the course of the treatments. There was albumen alone in 22, and 14 had both albumen and casts. In 12 the albumen appeared within the first twenty-four hours, and in 24 within the first three days following the injection. Casts appeared within the first twenty-four hours after four injections, and after eight within the first three days. Hæmaturia appeared on the first day after three injections and on the third day in a fourth case. There were no signs of permanent injury to the kidneys. Both albumen and casts disappeared within a few days, and in cases receiving from three to five injections, they did not always reappear after being present after the first injection; even in cases with hæmaturia, it did not reappear after subsequent injections.

The lead line on the gums sufficient to be easily observed was always associated with infected gums and teeth, and unless these were badly infected the line disappeared under proper hygiene. It was observed in eight cases after the first injection of 80 milligrams of lead, appearing in the earliest on the fourth day after an injection of 100 milligrams.

The Blood Changes.—The destruction of red cells began within the first twenty-four to thirty-six hours and made the chief difficulty in the clinical application of this method of treating malignant neoplasms. The maximum loss in red cells was 1,888,000 within two days, and the minimum 240,000 within seven days after a single injection. After fifty-one injections the average loss after each injection was 977,000, with little difference between the first and subsequent injections. The rapidity of the loss varied somewhat with dosage, reaching the lowest point after twelve injections within three days, after twenty-eight injections on the seventh day, and after thirty-six on the tenth day—the longest time being forty days. The lowest number of cells was 1,500,000, occurring on the fifth day after a second injection of

100 milligrams at an interval of only seven days. The rapidity of recovery in the number of red cells did not always vary with the severity of the loss—the recovery after the maximum losses often being comparatively rapid and satisfactory. The rapidity of recovery practically determined the intervals of treatment. For example, in one patient receiving five injections, the intervals were twenty-seven, fifty-two, twenty-three, and thirty-eight days, making a period of four months. In another, a child of five years of age, receiving four injections, the intervals were nine, thirty-three, and twenty days, making a period of two months.

Stippling occurred almost as uniformly as the decrease in the number of red cells, there being only two cases in which stippled red cells did not appear at some time during the course of the treatment. In one of these, only two injections totalling 40 milligrams were given: in the other only one injection of 80 milligrams. After nine injections the stippling was first observed within forty-eight hours, in four cases it did not appear until after the second injection, and in three not until after the fourth. The maximum number of stippled cells, occurring in four cases, were three to five in a field. In the others, they varied in number from one in the entire smear to three to five in ten or fifteen fields. In two instances they were described as coarse, but apparently without any clinical importance. Nucleated red cells appeared in eight instances—in three to a considerable number, and in four cases they were stippled. Poychromatophilia was observed in ten cases, amounting to a large number in three, and in two without stippling. In general, the stippling varied with the dosage and the severity of the anemia, diminishing in number with the recovery from the anemia. It often persisted, however, in an occasional cell after recovery from the anemia, remaining as the sole evidence of the lead toxicity. Another injection was often given while stippling was still present and it was not regarded as of the same clinical importance as the number of red cells. Regarding the white cell count, there was a transient and moderate leucocytosis, varying from 11,000 to 21,000 in ten patients, which in five instances was associated with infected tumors. In the others the increase in the number of white cells appeared to occur at the height of the more pronounced reactions, but it was not connected with a disturbance in the normal relations of the differential count, except in one patient in whom an abscess formed in an actively growing tumor.

Toxic Effects of the Lead upon the Health of the Patients.—We have observed that all of the signs of serious toxicity have appeared and disappeared within a few days after the injections have been given except the anemia, occasional nausea and vomiting and abdominal cramps, which also have disappeared before subsequent injections were given. As a result fifteen are living and six are dead. Of the latter, three lived from seven to ten months after the injections and three only six, five and two weeks, respectively. But even of those dying shortly after the injections, each had recovered from the effects of whatever lead toxicity they had shown, which

had been severe in only one case. Two died under the clinical setting of a pleurisy with effusion from the metastases or carcinoma of the breast. The other also has pleural metastases in addition to rapidly and widely disseminating tumors of the abdomen from a transitional cell carcinoma of the uterus. Of the three patients who lived a longer time, the disease progressed without any signs of the lead having a permanent effect upon the general condition. Striking evidence of the transitory nature of the lead toxicity is shown in four patients whose treatment was abandoned because of the apparent failure to affect the tumors. All have gained in weight and strength and are in better general condition than when the injections were begun. One of these cases was relieved markedly from pain.

Effects Upon the Tumors.—We have considerable evidence to show that the intravenous injection of colloidal lead, used either alone or in combination with radiation, can produce sufficient regression in certain types of tumor to confirm in part at least Blair Bell's results. In four out of seven cases of mammary cancer which received this treatment, appreciable regressions of the tumors occurred and in two cases the results might be designated as a temporary "clinical cure."

CASE I.—*An advanced ulcerating cancer of the breast, axilla and neck with multiple metastases to the pelvic bones and a pathological fracture of the right femur.* She was admitted to the hospital, suffering severe pain and marked prostration two months after the completion of a series of X-ray treatments, which had failed to stop the progress of the disease. All of the tumors had increased in size and the pathological fracture had been a recent event. Five days after the first injection of 90 milligrams of lead a softening and œdematous feeling of the tumor of the breast was observed, and within twenty days there was a definite regression of the tumors in the breast, axilla and neck. Pain, also, had disappeared, and the patient's general condition was improved. Twenty-seven days after the first injection a second of 75 milligrams was given, and two months after the first injection the soft part tumors had completely disappeared. Two weeks later—two and a half months after the first injection—an X-ray examination showed a regeneration of all of the bone lesions. During the third month two more injections of 75 milligrams each were given, followed in the fourth month after beginning of the injections by a steady gain in the general condition, no evidence of soft part tumors, and a continued and marked regeneration of all of the bone lesions, including a union of the pathological fracture. During the fifth month a final injection of 75 milligrams of lead was given, followed by a constant gain in every way for two months, when another metastasis appeared in the outer end of the right clavicle. At that time the red cell count was 4,200,000 and without any stippling. In view of the report by Hunter and Aub showing that by means of parathyroid extract—Collip lead, which is stored in the bones, may be mobilized along with the calcium, we administered Parathormone on several occasions to this patient. We hoped that in this way it might be possible to make use to some extent of the lead which had already been stored in the bones, and thus avoid subjecting the patient to further injections of lead. We did not analyze urine or fæces for lead, and are therefore unable to state whether the excretion of lead was increased. However, there did appear to be a distinct tendency for stippling to reappear following each period of parathyroid administration. While our dosage was small—10 units twice a day at first, and later three times a day—it was sufficient to increase the blood calcium to 15 mg. per 100 c.c., which is stated to be the maximum safe limit for the human subject. (McCann.) The radium pack was then applied and followed by a prompt regression which is not yet complete. Her general health

continues to improve without any signs of recurrence of the old tumors. This patient received 375 milligrams of lead within a period of 139 days—the largest amount that has been given to any patient.

CASE II.—*An advanced ulcerating cancer of the breast, axilla and neck.* No other metastases were found and the patient, although having lost considerably in weight, was not markedly cachectic. She had a moderate amount of pain. After two injections one week apart, of 100 milligrams each, the most severe reaction that we have observed occurred, characterized by nausea and vomiting, hæmaturia, jaundice with a marked swelling of the liver, and severe prostration. A rapid recovery, however, followed a transfusion. Three weeks after the first injection, a definite regression of the tumors of the breast, axilla and neck was observed, presenting the same œdematous feeling of the tissues which were observed in the first case. Six weeks after the first injection the ulcer showed signs of healing and the regression of the tumor in the breast appeared to be almost complete—possibly it was complete. Two X-ray applications were made, however, and all of the tumors completely disappeared and the ulcer healed. The regressions appeared to remain complete for two months, when a diffuse infiltrating tumor appeared in the other breast. A third injection of 75 milligrams of lead was given, without any reaction such as we were afraid might occur because of the severity of that which followed the second injection. A rapid regression resulted but did not become complete until an application of X-ray was made. Since then there has been observed no growth activity of the tumors. At least, there has been no gross evidence of existing tumors with the exception of numerous small discrete skin nodules which appeared on the chest wall near the periphery of the primary tumor during the eight months after the beginning of the treatment. A fourth injection of 75 milligrams of lead did not affect apparently these nodules until after an application of the radium pack. Since then all of them have disappeared. The patient's general condition has improved and now, almost one year since the beginning of the treatment, she presents no evidence of tumor.

CASE III.—*An advanced cancer of the breast with extensive metastases of the pleura and lungs,* from which she died five weeks after one injection of 75 milligrams. There had been complete recovery from the effects of the lead. A definite regression of the breast tumor was observed within one week after the injection, but there was no observable effect upon the progress of the pulmonary metastases.

CASE IV.—*Cancer of both breasts, axillæ and neck,* with marked cachexia, admitted to the hospital two months after the X-ray had failed to alter the progress of the disease. On the third day after a second injection of only 10 milligrams of lead, given five days apart, a definite line appeared on the chest wall, showing the flattening out of skin nodules within the area that had been treated by the X-ray as compared with the nodules outside of this area. No other evidence of the effects of the lead were observed, and the patient died six months later from the extension of the disease.

CASE V.—*Osteogenic sarcoma of the humerus.* A girl, fourteen years of age, presented an advanced lesion of the upper end of the humerus, which gave all of the clinical and radiological signs of a typical osteogenic sarcoma. The bone was so much destroyed that a pathological fracture had occurred and there was a bulky soft part tumor. Five days after the injection of 50 milligrams of lead the tumor began to soften. Radium was applied and three weeks after the injection pain had entirely disappeared and the tumor had become cystic throughout. Another injection of 50 milligrams was given four weeks after the first. Four days after this injection the tumor began to decrease in size, and continued to do so rapidly until two months after the first injection the soft part tumor had entirely disappeared. The X-ray examination at this time also showed well-marked bone production and healing of the fracture. Six weeks after the first injection the X-ray showed a small nodule in the lung which had disappeared apparently three months later. Four other injections of lead were given until a total of 354 milligrams had been given over a period of 157 days. Other radium

and X-ray treatments were given, and the patient has continued to gain in health until the present time, six months since the beginning of treatment. There appears to be union of the fracture, marked regeneration of the bone, and no evidence of a soft part tumor.

CASE VI.—*Osteogenic sarcoma of the femur.* A man, twenty-six years of age, applied to the hospital with a bulky tumor of the thigh which was found to be a typical advanced osteogenic sarcoma of the upper end of the femur. There was marked destruction of the bone and a pathological fracture. Two injections of 90 milligrams of lead at an interval of eighteen days were given, and two weeks after the second injection there had been no improvement. The soft part tumor, in fact, had increased in size and pain also had become much worse. The radium pack was then applied and almost immediately the tumor began to decrease in size, pain disappeared and within three weeks there was no evidence of a soft part tumor. The X-ray showed also a beginning regeneration of the bone. Two more injections of 90 milligrams have been given, and the patient is steadily improving in health, but is confined to his bed because the union of the fracture is not yet completed.

CASE VII.—*Osteogenic sarcoma of the rib.* A man, fifty years of age, presented a large semi-solid tumor of the chest wall. The X-ray examination showed an area of destruction of the ninth rib, with the typical picture of an osteogenic sarcoma. An exploratory operation had been done two months prior to admission. The tumor had grown rapidly since the operation and showed all the signs of infection. X-ray treatment failed to produce any changes. After two injections of 90 milligrams of lead, given at an interval of fourteen days, the tumor became definitely smaller, but has not decreased so rapidly as in the two previous cases. It is too early, however, to judge of the outcome. The treatment will be continued by the combination of lead injections and radiation.

CASE VIII.—*Ewing tumor.* A girl, five years of age, weighing thirty-one pounds, presented a bulky tumor of the left leg, upon which an operation had been done a few weeks previously under the diagnosis of osteomyelitis. The fibula was found to be the site of an endothelial myeloma. A large part of the fibula was excised with a tumor of the soft parts. It had recurred promptly and upon admission there was a bulky tumor of the soft parts and an actively growing tumor of the ends of the fibula. On December 3, 1926, a radium application was made and one week later 25 milligrams of lead were injected into a vein of the neck. The tumor completely disappeared eighteen days after the lead injection. The next day—nineteen days after the first—another injection of 33 milligrams was given, which was followed by a transient hæmaturia and pallor, but all of the signs of a lead reaction rapidly disappeared. Three weeks later the X-ray showed a marked regeneration of the bone. During the next month two other injections of 25 milligrams were given without any reactions, making a total of 108 milligrams given within seventy-three days. The patient has continued to gain in weight and strength and has remained without any appreciable evidence of tumor until the present, nearly five months since the beginning of the injections.

Discussion of the Results.—We have therefore observed regressive changes in the tumors of eight patients out of twenty-one who have received the lead injections either alone or in combination with the applications of the X-ray and radium. In two cases, however, the changes were transient and exerted no influence upon the course of the disease. One of these—a cancer of the breast, showed a definite regression of the primary tumor, shortly after the injections of lead alone, but had no apparent effect upon the metastases and the course of the disease. The other, also a cancer of the breast, showed regressional changes in the skin metastases where the

X-ray had been applied previously, but manifested no other changes. Such observations by themselves have little significance, but in connection with the greater effects observed in the six other cases, add a little to the evidence supporting the curative quality of lead in malignant neoplasms. The first criticism that naturally is suggested against estimating the value of lead in this series of cases is the fact that the injections of lead have been combined with the applications of the X-ray and radium. This criticism, however, is less valid amongst those who are experienced with the use of these agents alone. In Case I, mammary cancer with extensive bone lesions, in which the lead injections were not begun until two months after the X-ray had apparently failed to check the progress of the disease, the favorable effects observed after the lead injections may be ascribed to the late effects of the X-ray, which our experience has shown us does occur. But we have never seen such marked and prompt effects in these lesions before. In Case II, marked regressive changes were observed before the radiation was begun. In general, however, our observations indicate that the combined treatments accounted for the effects, and the observations are too few to estimate how much was due to the lead and how much to the radiation. We know, however, that with the exception of the case with the Ewing tumor, all of the tumors are radio-resistant, requiring large amounts of radiation skilfully applied to produce even partial regressions. It seems fair, therefore, to ascribe a considerable part of the changes to the lead. In the case of the Ewing tumor, we know that radio-sensitiveness is one of its features and we almost invariably observe prompt and apparently complete primary regressions after suitable radiation. But the failures to respond with such tumors occur frequently under the conditions that existed in this case—a rapidly growing and altered tumor immediately following an operation. It is rare also to observe such a complete and rapid regression with so much restoration of bone and function. Time, however, in this case must decide the real effects because by radiation alone recurrences or metastases have always finally occurred.

Regarding the theories of Blair Bell and others as to how the lead produces its effects either alone or in combination with the X-ray and radium, our observations do not allow us to make any dogmatic statements. The failure, however, of the lead, either alone, or in connection with radiation, to produce any favorable changes in the case of a malignant chorio-epithelioma of the vagina, which is secondary to a primary tumor of the uterus, does not tend to confirm Blair Bell's theory of selective action of lead upon trophoblastic cells. The idea of Clark that the metallic colloids act as do non-specific proteins, merits, we think, some consideration. Our observations of the changes in the bone tumors we have treated by a combination of lead and radiation tend to confirm the work of Aub, Fairhall, Minot, and Reznikoff, who found that the skeleton is the only tissue to retain any significant amount of lead. It also appears to suggest the accuracy of the conclusion of Martland

and others that the lead is stored in the bone-marrow as a part of the reticulo-endothelial system. Hothusen, in an elaborate monograph, reviews all of the literature relating to the various methods of increasing the radio-sensitiveness of tumors and concludes that little from a therapeutic standpoint has resulted. There were too many variable factors, he thinks, to make an estimate of the value of the different experiments. Regarding the efforts to increase the secondary radiations by the use of colloidal metals, he naïvely says that it is impossible to judge clinically because these colloids themselves may have a restraining power over the growth of neoplastic cells. It may be, therefore, that the effects upon tumors that have so far been observed by this method of therapy will reopen the field of chemotherapy and lead to some other and more effective substance.

CONCLUSIONS

I. It does not appear to us that the intravenous injection of lead offers a cure for malignant neoplasms.

II. Our experience suggests that in cancer of the breast, especially in the bone metastases from this tumor, the lead alone can produce favorable changes, and, if used in connection with radium or the X-ray, can cause, regression sufficiently complete in advanced cases to make greater palliation in radio-resistant tumors than has hitherto been accomplished.

III. In malignant osteogenic sarcoma, our experience strongly suggests that lead in conjunction with radiation offers a valuable method of treating such tumors.

IV. We have no theory to offer as to how the lead produces changes in tumor tissues, but our failure to observe any favorable change in a case of malignant chorio-epithelioma does not tend to confirm Blair Bell's theory of its selective action upon trophoblastic cells.

V. We are unable to make an accurate comparison of our clinical results with those of Blair Bell, but they have been produced with less amounts of lead and, apparently with less constitutional damage.

VI. Changes have been observed in tumors after one injection of 80 milligrams.

VII. We have not made our injections at definite intervals, always awaiting a satisfactory recovery of the patient from the previous injection before giving another.

VIII. With our preparation of sol it has been unnecessary to use gelatin or other protective agent.

IX. Expressed in terms of milligrams of colloidal lead, we do not advise a single dose of over 90 milligrams in any case, and are inclined to think that 75 milligrams will be a safer amount and will produce the same clinical effects upon the tumors. For patients weighing less than 100 pounds, we think that a dose of approximately 1.5 to 2 milligrams per kilo of body weight will offer a fair guide.

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MULTIPLE GIANT-CELL TUMORS*

REPORT OF A CASE AND REVIEW OF THE LITERATURE

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Giant-cell tumors have held a very prominent place in American studies and discussions of bone pathology since Bloodgood, in 1910, called attention to the benign character of this condition and in 1912 recommended the name which now is in common use. Single giant-cell tumors are not uncommon. The literature contains reports of several hundred cases and there are undoubtedly many more that have not been reported. Multiple giant-cell tumors, however, are sufficiently rare to warrant our reporting this case with a résumé of the previous cases which we have found in American and foreign literature.

Case.—J. M., age twenty-two years, well developed, well nourished, but rather anæmic white male, was admitted to the Episcopal Hospital, service of Doctor Alexander, on October 20, 1926, with a fracture of both femurs in the middle third and the right humerus at the junction of the upper and middle third.

Family History.—Father, mother, four brothers and one sister living and well. Grandmother died of cancer. Family history otherwise negative.

Personal History.—Measles, chickenpox and tonsillitis in childhood. Operation for varicocele at the age of fourteen years. Operation for a ruptured right ligamentum patellæ, January, 1925 (X-rays of the right knee taken at that time showed beginning bone changes). Injury to the right arm two weeks before admission showed no fracture in X-ray but a pathological bone condition suggestive of chronic cystic osteitis of the shaft of the right lower humerus and ulna. Punched-out areas were seen in the lower end of the humerus and periosteal proliferation along the border of the ulna, which in certain places had a lacework appearance.

The patient's habits are good. He has considered himself in good health but gives a history of rheumatism in the knees for the past four months, with sharp deep pains in the legs, which were worse in bad weather. He has lost twenty pounds of weight in the last five weeks. No history of venereal infection.

Present Illness.—Patient slipped and fell in the bath tub and broke both femurs and the right humerus. He was brought immediately to the hospital. Buck's extension and Volkmann's sliding splints were applied to both legs and the right arm was dressed with a shoulder cap and right-angle splint. This was changed after several days to a weight extension dressing.

Physical Examination.—Patient is a well-nourished white male, about five feet ten inches in height and weighing about 180 pounds, appearing rather anæmic.

Head.—Is negative except that the teeth are in poor condition and pyorrhœa is present. There is a hoarseness of the voice which was later found to be due to paralysis of the left true vocal cord, which had come on following an anæsthetic eighteen months

* Read before the Philadelphia Academy of Surgery, April 4, 1927.

previously. There is a small tumorous swelling in the right mandible near its angle, the result of an injury while boxing.

Chest.—Heart and lungs are negative. No nodules are found on the ribs.

Abdomen.—Negative.

Extremities.—Show fractures of both femurs and the right humerus, with displacement, pain; swelling and crepitus. There is a scar over the right knee from previous operation. There is swelling of the lower end of the left radius.

Progress Notes.—October 20, 1926: X-ray examination. Besides the fractures all bones were involved in a pathological condition and was interpreted as follows:

"There is a generalized fibro-cystic osteitis with an atypical appearance in different regions, which in the distal end of the radius and the lower extremity of the left femur has advanced to that of a giant-cell tumor. In the region of the elbows, it has the appearance of a chronic osteomyelitis. In the right femur the appearance suggests strongly the possibility that the process has undergone a sarcomatous degeneration.

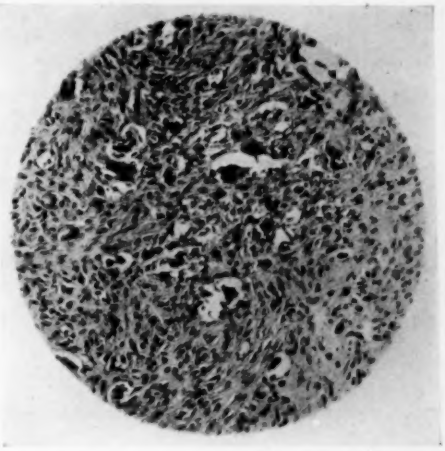

FIG. 1.—High power view of the tissue taken from the lower end of the left radius.

November 8, 1926.—Biopsy of the tumor of the left radius. Pre-operative diagnosis, giant-cell tumor. Under nitrous oxide and oxygen anæsthesia an incision four cm. long was made on the dorsal aspect, over the tumor, of the lower end of the left radius. Cultures were made from the skin, subcutaneous tissues, fascia, periosteum and medullary cavity. When the periosteum had been shoved aside with a small separator a piece of bone sufficient for study was quite easily removed. It was shell-like about one mm. in thickness and the curette easily broke through into the medullary cavity. The contents of the cavity was a soft, red, bloody spleen-like pulp. Some of this material was also taken for study. There was a slight bloody ooze, but the incision was closed completely with interrupted silkworm gut suture. The wound healed by first intention within ten days. Pathological report of biopsy was giant-cell tumor, and the cultures taken were negative for organisms.

November 23, 1926.—X-ray of the lower end of both tibias and fibulas and of the bones of the feet and ankles showed the same moth-eaten areas as elsewhere. The pelvis showed mottling and there was a pathological fracture of the femur of the left leg, not discovered clinically. X-ray of the chest showed the lungs not infiltrated with metastatic neoplasm, but the eleventh left rib showed a tumor at its angle.

December 9, 1926.—Biopsy of the left ulna. Pre-operative diagnosis—chronic osteomyelitis; incision was made over the upper part of the ulna so that the bone was exposed about five cm. below the tip of the olecranon. Cultures from the skin, fascia, periosteum and bone were taken. The bone was found to be roughened and not as hard and compact as normal bone. No medullary substance was exposed. A small piece of bone was removed and the incision closed. The wound healed by first intention. Pathological report was giant-cell tumor and the cultures were sterile.

Biopsy of the tumor at the lower end of the right femur revealed a condition similar to that of the left radius. The bone tissue was shell-like, one or two mm. thick, and the marrow a spleen-like pulp; there was a great deal of hemorrhage. Bone and marrow tissue were removed for study and cultures were taken as in previous operation. A rubber tissue drain was inserted and the incision closed with interrupted sutures. The

wound healed by first intention except at the site of the drain and this healed by rapid granulation. Pre-operative diagnosis was sarcoma. Laboratory diagnosis was giant-cell tumor and again the cultures showed no growth.

December 13, 1926.—Areas of right radius, left ulna and right femur, from which biopsies were taken, have a more extensive moth-eaten appearance, as shown by X-ray.

December 31, 1926.—Clinically there is only fibrous union of the fractures. All weight extensions have been removed (seventy-two days after admission).

January 28, 1927.—By X-ray the fracture of the right humerus showed excellent callous formation (100 days after fracture). "There should be some bony union. There also seems to be some calcium deposition within the bone. There is practically no change in appearance of the left forearm. There is slight callous formation about the fracture of the left femur, but very little if any calcium deposition."

FIG. 2.—Section from the giant-cell tumor at distal end of left radius.

January 31, 1927.—Patient is up in a wheel chair. He can use his right arm to feed himself. He has a good appetite and is clinically improved. There is a false joint at the site of fracture. There is non-union and non-use of the femurs.

Laboratory Data.—Urine negative for Bence-Jones albumin on three occasions, a trace of albumin with an occasional granular cast. Blood nitrogen and blood sugar normal. Icterus index 11.2. Van den Berg negative. Hæmoglobin 50 per cent. Red blood-cells 2,830,000. White blood-cells 20,600. Polymorphonuclears 92 per cent. Transitionals 1. Lymphocytes 15 per cent. Eosinophiles 2 per cent. Aniscytosis and Poikelocytosis present. Blood calcium 15.4 mgm. per 100 c.c. Blood phosphorus 2.1 mgm. per 100 c.c. Spinal and blood Wassermann negative. Spinal colloidal gold negative. Spinal fluid cells 2 per cu. mm.

CASES IN AMERICAN LITERATURE

CASE I.—CRILE AND HALL.—A young unmarried woman, aged twenty-two years; X-ray pictures of the skeleton showed numerous bones involved in a pathologic process; operation was performed on a lesion in the right tibia; gross and microscopic study was made of the contents and a diagnosis of multiple giant-cell tumor was made. The etiologic factor was not ascertained. The history states that the patient's mother had syphilis and her father diabetes. The patient had no evidence of acquired lues and also failed to improve on anti-luetic treatment. However, it was noted that the exploratory wound gave no evidence of healing until the patient was put on iodide therapy. Prompt healing of the wound then resulted. Ten years later (1915) when the case was seen by Doctor Hirsch in the Bellevue Hospital, there were numerous masses, apparently attached to all the bones. X-ray revealed multiple multilocular cystic tumors which were diagnosed multiple giant-cell tumors.

CASE II.—HARTUNG AND KANAVEL.—Male, thirty-four years, a carpenter, admitted to the hospital with an ununited fracture of the left femur sustained six months previously. Patient walked with a cane and crutch. A diagnosis of bone cyst was made. Four years later he had involvement of both clavicles, several ribs, right ulna, tibia and fibula, right humerus and femur, left tibia and one metatarsal, and an old fracture of the left hip. Three years later the case was presented to the Chicago Surgical

Society. Several cysts had been scraped out and revealed a pathological picture of giant-cell tumor.

CASE III.—HAUSSLING AND MARTLAND.—A married woman, twenty-five years old, has had four normal deliveries and one miscarriage in which there was much hemorrhage and following which she had weakness, dyspnœa, palpitation on exertion. She fell and broke a femur six inches above the knee in October, 1914. There was union without deformity. May, 1915, she had a full-term labor. In June, 1915, she was admitted to the hospital because of weakness and dyspnœa. Examination of the heart showed a loud systolic murmur and the lungs with signs of early tuberculosis in the left upper lobe. Palpable tumors were found in the right orbit, both clavicles, left tibia, and seventh right rib, and further, by X-ray, in the right femur, right and left fibulas, right humerus and in the pelvis. Biopsy of the growth on the left tibia showed a characteristic giant-cell tumor. Curettage of several tumors was later done. Incisions united by primary union. The tumors recurred and later others were also found elsewhere.

CASE IV.—BARRIE.—White male, aged fifty years, married, youngest child eighteen years old. Wife had no miscarriages. Denies venereal infection. Had sciatic rheumatism fifteen years previously, attacks of weakness of legs and feet eight years ago, and again seven years ago. All teeth extracted six years previously. Diagnosed amyotrophic lateral sclerosis five years ago. While on his way to the hospital for this admission he had an accident and fractured the eighth, ninth and tenth ribs. X-ray showed areas of osteolysis in the long bones of the lower extremities, the ribs on the right side, the fractures being through the pathological areas. There was a mass on the right tibia the size of a hen's egg. Diagnosis of multiple gumma was made, and treatment given without result. Exploratory operation of the tumor on the left tibia revealed giant-cell tumor.

CASES IN FOREIGN LITERATURE

CASE I.—HIRSCHSPRUNG.—Female, thirty-five years old, fell and fractured the left hip. Had union with shortening. Also had a periosteal swelling of the left shin bone. Four years later she was admitted and treated for rheumatism and periostitis, and died of marasmus. Post-mortem showed no changes in internal organs. Left humerus had a healed fracture at the anatomical neck, the left tibia a healed fracture in its middle, and the left femur a healed fracture at its neck. The bones at the site of fractures were soft and cystic and in the tibia at the site of fracture was a small giant-cell sarcoma.

CASE II.—SCHOENENBERGER.—Female, thirty-three years of age, no previous illnesses. During her third pregnancy developed pain in the back and limbs, which persisted after labor and was treated as a chronic articular rheumatism. She was admitted to the hospital because of this pain, and acute joint pain followed by swelling of the bones. She had multiple fractures due to slight trauma. Autopsy later showed fracture of the right and left humerus, right and left femurs, lordosis of the lower thoracic vertebræ, fracture of numerous ribs, cyst-like tumors of the left tibia and right tibia and fibula and humerus, both femurs, pelvis, etc., which proved microscopically to be giant-cell sarcoma.

CASE III.—SCHLANGE.—Male, eighteen years of age, had a fracture in the middle of the femur five years previously. After healing there was pain and deformity of the leg. Operation revealed a cyst three cm. long with serous fluid, and a second cyst the size of a walnut, extending into the greater trochanter. Microscopic examination showed the bases of the tumor masses to be cellular connective tissue with delicate bone formation, and in the region of the area of softening numerous giant-cells.

CASE IV.—REHN.—Female, twenty-three years of age; admitted because of pain in the right hip with visible swelling. Discharged after two and one-half months slightly improved. Re-admitted ten months after onset with pain and a rapidly growing tumor at the distal end of the right ulnar. It was removed at operation. Examination revealed

a gray, red, friable mass and microscopically giant-cell sarcoma. Two months later the shaft of the right femur, right ileum and right humerus were affected. Biopsy of the right ileum tumor revealed a giant-cell sarcoma. Several months later the right lower leg, eighth and ninth ribs, left sacro-iliac joint, and left tibia were all involved. Operation on the sacro-iliac joint because of pain showed giant-cell sarcoma also. One year later tumors had increased in size and number and there was a spontaneous fracture of both femurs, which healed. There was progressive deformity due to fractures and softening of the bones. Patient died four years later of anasarca.

CASE V.—HABERER.—Boy, ten years of age, well until three years ago, and has developed irregular increasing, painless swellings of the right side of the head and face. There was a five-year-old slight traumatic fracture of the right femur in the middle third which had healed with deformity, and three years later slight trauma had increased the deformity. X-ray showed lesions in the right parietal region, lower jaw, right femur, left trochanter, left coxa vara. Exploratory operation showed that after cutting through the thin cortex multilocular hemorrhagic cavities, filled with soft, red, brown, sarcomatous masses were found. Microscopically, it showed widely disseminated giant-cells and spicules of bone. Diagnosis: Giant-cell sarcoma. Progress was benign.

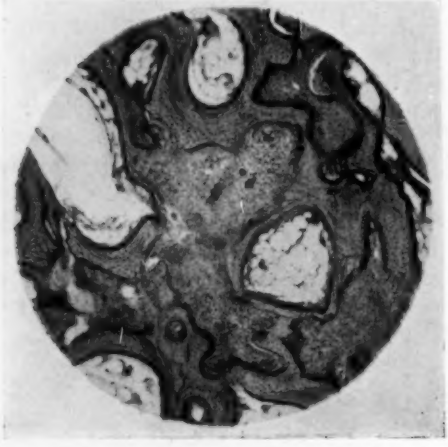

FIG. 3.—Section taken from the crest of the left ulna about five cm. from olecranon.

CASE VI.—HART.—Female, seventy-eight years of age, well until sixty-eight years of age, and lived in an Old Folks' Home, had a spontaneous fracture of the femur while lying in bed. She died of hypostatic pneumonia and suppurating bronchitis. At post-mortem, skeletal tumors were found in both femurs, both tibias, pelvis, ribs, right humerus, elbow, radius, eighth and ninth thoracic vertebra, all due to giant-cell sarcoma and cysts.

CASE VII.—GUENTHER.—Reported a case of Fischer's. Carpenter, age forty-six years, came to autopsy with a diagnosis of osteomalacia. Anatomical diagnosis was multiple tumors, myelomatous and myelosarcomatous, throughout the bony system, with fractures of both femurs, the left humerus, and a tumor of the right parathyroid. Microscopically the bone tumors showed the picture of giant-cell tumor of the epulis type.

He also quotes Schmoil as reporting four cases of osteomalacia with parathyroid changes, and Mollineau's case of osteitis fibrosa with multiple giant-cell sarcoma in which three of the parathyroid bodies showed changes. He also collected two other cases to show the relation between malacia of bone and parathyroid bodies.

CASES OF FIBROCYSTIC OSTEITIS WITH ASSOCIATED MULTIPLE GIANT-CELL TUMORS

MOXTON (*Archives of Surgery*, 1922, vol. iv, p. 534) has carefully studied and analyzed many cases of fibrocystic osteitis with giant-cell sarcoma from which we briefly quote the following cases:

(*a*) WERNDORFF.—Male, age nine years, with tumors in the right femur and right tibia, duration from earliest childhood, causing deformity of the right leg. Resection of the tumor of the right femur proved to be giant-cell sarcoma.

(*b*) BUTLIN.—Male, age fifty years, who since he has been forty-three years old

has had tumorous masses growing on the jaw and on the sixth right rib. At autopsy these were found to be giant-cell tumors.

(*c*) Female, age forty years, had tumorous formations on the upper and lower jaw, duration ten years, causing swelling, and when removed and studied were found to be giant-cell tumors.

(*d*) DAVIDSOHN.—Male, fifty-eight years old, with tumors of the tibia, patella and femurs, discovered five years previously. Came to autopsy and showed giant-cell tumors.

(*e*) GAUGELE.—Female, age thirty-six years, who had shown symptoms since twenty-eight years old, the tibia, humerus and ulna being involved. The symptoms were fractures, swellings, deformity, anæmia and emaciation. Pathological report indicated giant-cell sarcoma.

(*f*) VON RECKLINGHAUSEN, 1891, CASE VII.—Female, age forty years, with tumors of the left ileum, upper and lower jaws, radius, tibia, ribs, fibula and femur, and who had been treated for pain, fractures and deformity, died of marasmus. The pathological report included giant-cell sarcoma.

(*g*) LOTSCH.—Reported a case, age fifty-seven years, who dated the onset of his condition ten years previously, who showed tumors of both tibias. Exploratory operation was done which showed giant-cell tumors.

(*h*) MONCKEBERG.—Female, aged fifty-five years, who since thirty-nine years of age has had a tumor of the jaw and another tumor of the ninth rib. The tumor of the jaw was extirpated three times and it showed a giant-cell tumor.

FIG. 4.—Section taken from right femur at biopsy, December 9, 1926.

CASES SUBMITTED TO THE SARCOMA REGISTRY

From a recent communication from Dr. B. C. Crowell, we add the following cases which have been submitted to but not definitely decided upon by the Committee on Bone Sarcoma:

CASE 70.—Dr. R. E. FORT, Nashville, Tenn. Date of onset about November 12, 1912. A boy of eleven with a tumor of the first rib. July 23, 1913, excision of first rib, clavicle and part of sternum. Post-operative Coley toxins. Registrar's classification—Giant-cell tumor. Late note, May, 1923—well. Published in *Surgery, Gyn., and Obst.*, June, 1914, pp. 696-698. September, 1924—well. May 1, 1925—well.

CASE 110.—DR. J. C. BLOODGOOD, Baltimore, Md. Date of onset about 1917. A man of twenty-seven with a tumor of the upper end of the tibia and femur. July, 1920, exploratory incision by family doctor. Sinuses followed. November 27, 1920, amputation of femur by Doctor Carr. Registrar's classification—giant-cell tumor. Last note March, 1921—well.

NOTE.—A recent communication from Doctor Bloodgood states that he has three cases of multiple giant-cell tumors which he has not published.

CASE 167.—DR. JAMES EWING, New York, N. Y. Date of onset January, 1918. A boy of ten with a large tumor of the pubis, ischium and acetabulum. Pathologic fracture. Very clearly a giant-cell tumor from X-ray. No incision. Treatment: Fixation and radium. Registrar's classification—giant-cell tumor (X-ray diagnosis only). Last note, June, 1923—well, good function. July 12, 1924, no change. July 9, 1925—well. October, 1926, no further report.

CASE 212.—DR. DAVID CHEEVER, for the Peter Brent Brigham Hospital Clinic.

Date of onset April, 1920. A man of twenty-four with a tumor of the lower end of the left tibia and the fibula. Previous operations, about July, 1920, diagnosis was made of giant-cell sarcoma; recurrence and second operation March, 1921, followed by radium and X-ray treatments. Incision has never healed, continued lameness and soreness, although patient was able to work. Admitted to Peter Brent Brigham Hospital, April 20, 1922.

FIG. 5.—Left radius and ulna showing a giant-cell tumor.

Examination showed nearly complete destruction of lower end of tibia, marked involvement of fibula and invasion of ankle-joint. Patient developed a severe pyogenic infection from the unhealed wound from which tumor tissue was sprouting and had to have multiple incisions of leg and thigh. Amputation of the lower leg was done July 13, 1922. Patient discharged with stump well healed on July 28, 1922. X-ray of rest of skeleton and lungs negative. Pathological examination—giant-cell tumor. Registrar's

classification—giant-cell tumor. Last note, April 7, 1924, well, wearing artificial leg. July 23, 1926, no further report.

CASE 590.—DR. G. E. PFAHLER, Philadelphia, Pa. Date of onset, 1919. A man forty-two with a large tumor involving upper end of the femur, pubes, acetabulum and ischium. Case diagnosed as osteo-sarcoma at Samaritan Hospital, May, 1922. October 9, 1922, admitted to Medico-Chi Hospital. Pain first noticed in the knee three years before admission and a little later pain in the left hip. Eleven months before admission noticed a lump in the left groin. On admission, leg flexed and unable to step on foot. Treated by X-ray from October 9, 1922, to October 16, 1923. Marked improvement, and in two months was able to leave the hospital.

Registrar's classification—Benign giant-cell tumor. Last note, October, 1924, has been using the leg and working for the past year and a half. To have further radiation because of arrest of calcification in tumor. February 10, 1925, further X-ray studies showed that the head of the femur is destroyed. Having increased pain. No increase in calcification. Hip-joint ankylosed.

FIG. 6.—Left ulna showing the area from which biopsy was taken.

DISCUSSION

Giant-cell tumor, giant-cell sarcoma, hemorrhagic osseous dystrophia, myeloid sarcoma, myeloma, osteitis fibrosa with giant-cells, chronic hemorrhagic osteomyelitis and "brown tumors" are all terms used with reference to a similar bone condition. The subject was much studied between 1840 and 1860. Lebert, in 1845, was probably the first to recognize the condition. It was later described by Paget in 1854, and later by Nélaton in 1860 in an elaborate monograph.

Nélaton emphasized the proliferation of giant-cells, myeloplacques, as the essential factor in the process. He insisted that the giant-cells must predominate in the tissue and not be present merely in small numbers, since such cells were occasionally seen in other tumors. He recognized several other anatomic varieties, depending on location, conformation, structure and stage of evolution of the tumor. The age of incidence was mainly between fifteen and

twenty-five years. Without the aid of the microscope diagnosis was usually impossible. Regarding prognosis, Nélaton was quite specific, saying that every tumor composed essentially of giant-cells should be regarded as benign. He also advocated cauterization with zinc chloride following curettage, since the tumor would generally recur if any fragment was left.

Virchow (1864) is often quoted as emphasizing the malignant behavior

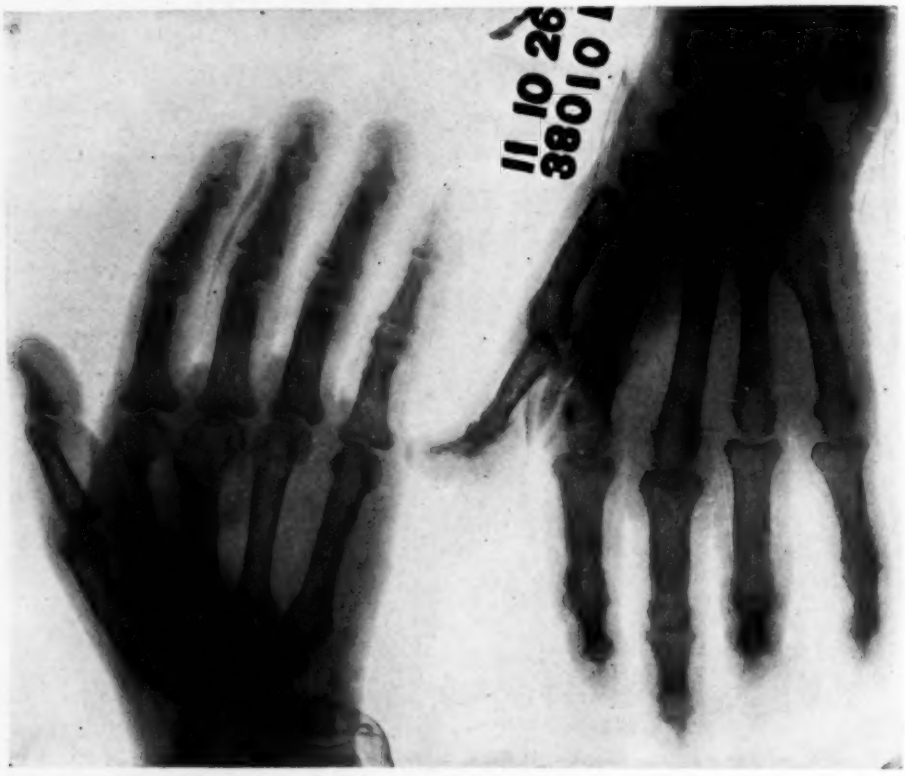

FIG. 7.—Both hands: showing a giant-cell tumor of the distal end of third metacarpal, right hand, and showing also the typical moth-eaten appearance of bones of the hands.

of certain myeloid sarcomas, but was unable to demonstrate that any of his malignant cases had not been such from the beginning.

Gross, in 1879, described in detail the features of giant-cell sarcoma, analyzing seventy cases from various sources and emphasizing their benign character.

In America, the facts established regarding giant-cell tumors seem to have been largely disregarded for many years and most of the tumors were subject to radical operation, until Bloodgood, in 1910, called attention to the benign character of the disease.

Giant-cell tumor is a specific tumor, believed to take origin from the fibrous tissue framework of the bone, whether periosteum or endosteum, and characterized by the invariable presence of osteoclast-like giant-cells in large numbers. It has at various times been considered the result of bone destruc-

tion due to spirochæte, tuberculosis, infectious bacteria and parasites, trauma, malnutrition and metabolic change. While it must be recognized that the solitary local process and the multiple systemic lesions give exactly similar gross and microscopic pathologic findings, it is also quite clear that the etiologic factors bringing about these apparently identical conditions are varied. In most cases the cause of solitary lesions is trauma. Von Recklinghausen regarded the systemic multiple lesions as different forms of malacia Guenther, more recently, believes it is due to a lack in the balance of bone chemistry associated with parathyroid disturbance.

FIG. 8.—Right knee showing evidence of a giant-cell tumor at upper end of the tibia

Giant-cell tumor classification has created much discussion. One school considers it neoplastic and another inflammatory, while a third states that it is a border-line lesion between these two. It is generally considered, however, as resulting from some chronic irritation, which may follow a metabolic disorder. The lack of calcium deposition weakens the bony structure; local injury, the stress and strain of motion and work, organisms etc., are all irritants.

The inflammatory proliferation of tissue is then essentially a regenerative process which has for its aim the compensation of the lesion produced by the cause of inflammation. Under special conditions this leads to a hyperplastic proliferation of connective tissue, frustrates its own aim and causes new damage. This is particularly the case when, as a result of the inflammation in the organism, there is kept up a permanent condition of inflammation. The bone tissue thus replaced by cellular tissue, softens and produces multiple

bone cysts lined with fibrous tissue and filled with clear fluid, fibro-cystic osteitis, or within the fibrous tissue lining the giant-cell tumor develops.

The giant-cell tumor usually arises in the interior of the shaft of long bones near the epiphyses. It is of slow growth, does not produce metastasis or cachexia, expands the bone abruptly, and in the X-ray appears trabeculated. The bone may be so thin as to crackle, and when cut is quite soft, vascular and resembles splenic tissue, but having a firmer opaque texture on the surface and central softer, cystic, or hemorrhagic areas. There is seldom any tendency toward invasion of the soft parts. Microscopically the framework has much the appearance of granulation tissue with hemorrhagic areas and abundance of large giant-cells containing many small oval nuclei.

According to Mallory, there are two types of giant-cells, a tumor giant-cell and a foreign body giant-cell. The former are large, clear, bladder-like cells, with distinct outline but staining faintly, within which are multiple nuclei, or a large multilobulated nucleus with mitotic figures, which stain deeply and are situated in the centre of the cell. They are usually not important features of the microscopic picture, but may be numerous and conspicuous. They are true tumor cells resulting from multiple mitosis and signify rapid growth. The second type are as a rule smaller, their cytoplasm fairly abundant, sharply defined and staining deeply with acid dyes. The nuclei are smaller, uniform, more numerous, without mitosis, and are often in clusters near the periphery of the cell. They resemble osteoclasts and are merely a reaction to the presence of foreign bodies and are due to the fusion of endothelial leucocytes.

Von Hansmann has classified giant-cells briefly as follows:

1. Foreign body giant-cells of endothelial or leucocytic origin.

2. Parenchymatous giant-cells, tumor-cells proper, due to irregular mitosis and lack of cell division.

3. Myelopaxes, present normally in red bone-marrow and characteristic constituents of myelomata.

The giant-cells of our own giant-cell tumor would be in Mallory's class two, and Von Hansmann's class one.

Giant-cell tumors may be present an indefinite time without giving rise to any symptoms. Often the first indication of their presence is the occurrence of pathologic fractures. In our case, after reviewing the films, X-ray shows beginning bone changes eighteen months before the patient was brought to the hospital with symptoms; also, we have done biopsy on areas absolutely symptom-free and found early giant-cell tumor formation. However, according to the location of the tumors, they may cause pain due to expansion and pressure on the soft parts.

Diagnosis is made by biopsy and microscopic examination, or may in a few cases be made by röntgenogram.

The treatment of single or multiple giant-cell tumors, when few in number, consists of thorough curettage and the application of pure carbolic acid, followed by the use of alcohol, or perhaps, better still, 20 per cent. zinc

chloride. The cavity is then kept clean with Dakin's solution until healed. Coley, in 1924, advocated the additional use of mixed toxins of erysipelas and bacillus prodigiosus, given systematically for a period of three or four months, and if available, one massive dose of radium, made over the tumor after the danger of infection is over or when the sinus has entirely healed. X-ray treatment is said to give great benefit, if not a cure.

CONCLUSIONS

1. Giant-cell tumors, especially multiple tumors, are being found more prevalent than previously, due to the X-ray.

2. No cases of multiple giant-cell tumors have been accepted as true entities by the Committee on Bone Sarcoma. (Doctor Codman, in a recent communication, states that he is skeptical about the existence of the condition.)

3. We report this case without knowing what previous pathologic condition existed at the areas biopsied, nor what change may take place in the course of a few years, should the patient live, but we have selected areas which should show different stages and we have found them to be multiple giant-cell tumors.

4. We have attempted to collect the cases from the literature in which multiple giant-cell tumors were believed to exist either alone or in conjunction with other bone changes.

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THE PRINCIPLES UNDERLYING THE SURGERY OF CARCINOMA OF THE RECTUM*

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There is no major operation of surgery concerning which there still exists such a divergence of opinion and method as in carcinoma of the rectum. This year (1927) we begin the second century of the development of the subject for it was in 1826 that Lisfranc first performed the operations which entitle him to rank as the father of major surgery of the rectum. It is true that Paget in 1739 first amputated the rectum for cancer, but his attempt, disappointing in its result, led to no development. Lisfranc's operation, still known by his name, consisted in liberation of the lower segment of the rectum through elliptical incisions encircling the anus, the bowel being amputated above the tumor. The progress of the operation for many years consisted chiefly in efforts to increase the exposure and enlarge the limits of excision. Lisfranc himself in later cases split the mobilized rectum in order to determine the upper limits of the growth. Denonvilliers added an incision posterior to the anus reaching to the tip of the coccyx. Verneuil and Kocher excised the coccyx and gained room for resection and anastomosis in suitable cases, thus preserving the sphincter function. Dieffenbach made two incisions, one anterior, the other posterior to the rectum in the midline which were deepened to the level of the tumor above which point the bowel was mobilized, excised and its upper segment brought down to the cleft perineum which was repaired to preserve the sphincter. The results of these and other modifications, however, were such that English surgeons stoutly maintained the advantage of colostomy which merely prolonged life and made it more comfortable. The French held to rectotomy and the Germans practiced ablation when the growth was low enough to be accessible. Franks remarked that the indication for operation depended much more on the nationality of the surgeon than upon the condition of the patient.

The great stimulus to more radical surgery came with Kraske's paper in 1885, describing a method of approach by removing the coccyx and a portion of the sacrum. This afforded opportunity for extensive removal of the rectum and perirectal tissues. High lying growths could now be reached and even the lower sigmoid could be mobilized. Kraske held to the advisability of preserving the sphincter when not directly involved by the growth. He practiced anastomosis of the upper segment with the lower, but later finding that the line of suture usually gave way posteriorly, he contented himself with making a partial anastomosis anteriorly, leaving the posterior portion to be closed by a plastic procedure at a later stage. When anastomosis could not be made, a sacral or gluteal anus was made. Kraske's proposals imme-

* The Annual Oration in Surgery, before the Philadelphia Academy of Surgery, March 7, 1927.

diately gained many adherents. Various technical modifications followed rapidly, giving names to a confusing multiplicity of operations. To a great extent these operations owed their claim to special name to a modification of the means of approach. Kraske removed a portion of the sacrum along a curved line beginning on the left side at the level of the third foramen and terminating at the left cornu. Hochenegg's resection of the sacrum began at the same point as Kraske's, but crossed the midline, curving downward to end at the right cornu. Bardenheuer sectioned the sacrum transversely at the level of the third foramen. Rose carried his incision in a curved line with convexity above, including the third foramen. As a result of the disturbances of innervation of these high sections, Heinecke and Levy devised plastic sections of the lower sacrum, the fragments being reflected like a hinge and replaced after the operation was concluded. Zuckerkandl and Wolfler incised the soft tissues to left and right, respectively, of the coccyx and sacrum and avoided division of the bone.

Other modifications concerned the treatment of the bowel. Maunsell and Weir devised a method of telescoping the mobilized bowel through the anus and making an anastomosis outside the body, after which the line of suture was again reduced through the anus. Hochenegg perfected his "durchziehungsmethod" in which the superior end of the rectum or lower sigmoid is drawn through the anal canal, the mucosa of which has previously been removed. This obviates the necessity of making an anastomosis by suture, with its frequent complications due to separation of the ends or later stricture at the line of union.

The distinguishing characteristic of the German school lay in its development of the inferior or sacral method of approach and adherence to the principle of conserving the sphincter, providing it be uninvolved and the upper bowel sufficiently mobile to reach the perineum. Failing in this a sacral or gluteal anus would be established. They have therefore avoided a preliminary colostomy except in cases of obstruction. Laparotomy has met with little favor except in those cases where special difficulties existed due to height of growth or fixity or evidence of obstruction.

Let us now consider the results of the classical sacral operations. For this an abundance of material is available, but when analyzed there are few homogeneous series because of the many variations in technic by different operators and by the same operator at different periods. The greatest consistent series is that of Hochenegg, whose early and sustained interest in the problem has resulted in an experience of over 1500 cases, 800 of which were subjected to operation. Mandl's exhaustive analysis of this material contains a wealth of observations on all aspects of the condition. The combined operation has been steadfastly rejected except for a few cases absolutely inoperable from below. In his hands therefore this procedure has had a prohibitive mortality and poor results. The series is all the more useful in assessing the possibilities and results of low excision. There were 508 radical operations, an operability of 66.7 per cent. Four hundred and sixty-one cases were

treated by radical sacral operation, of which 234 were one-stage amputations with sacral anus and 205 resections with reëstablishment of continuity. Of the amputations, 33 died (14.1 per cent.). 161 patients were followed. Sixty-seven lived over three years. Mandl calculates the end results on the basis of traced patients which must be corrected to make them comparable to our figures which are based on total numbers, counting untraced patients as dead. This corrected result shows 24.3 per cent. three-year "cures," or deducting primary deaths, 33.3 per cent. Data given is insufficient to calculate five years survivals, but 10 cases died of recurrence between three and five years. Of 205 resections 18 died (8.78 per cent.). One hundred and thirty-eight cases were traced for three years. Fifty-eight were living without recurrence (23.4 per cent.) or, deducting primary deaths, 31 per cent. three-year "cures."

Another great collection of figures is from the Breslau clinic reported by Eichhoff. This comprises 1021 cases, of whom 610 were accepted for treatment and only 326 submitted to radical operation, an operability of 31.9 per cent. Although this clinic has adhered to sacral removal, the series lacks homogenity in many respects, as it stretches from the year 1879 through the regimé of Fischer, Von Mikulicz, and the rest of Küttner's predecessors. A great variety of procedures were employed. Of the 326 radical operations, 79 died as a consequence of operation (24 per cent.). Eighty-seven were alive and well at the end of three years (26.7 per cent.), or excluding primary deaths (35.6 per cent.). These are high figures but the very low operability must be borne in mind. Küttner's "vorlagerungsmethod" which is now in use in this clinic consists in liberating in the usual manner by the sacral approach, the bowel and its surrounding tissue which is allowed to remain *in situ* until the following day when amputation or resection, as the case may demand, is performed. This second stage is simple and usually done without anæsthesia. Küttner has had 44 cases with primary mortality of 22.7 per cent. The end results he claims are superior but as yet no comparable figure can be obtained.

The most recent champion of the perineal approach is Lockhart-Mummery, who is a proselyte from the combined method which he formerly advocated. His chief reason for shifting his position was the mortality of the combined procedure. He has returned to the plan of preliminary colostomy and exploration followed in a week or so by perineal amputation. In 1925, Gabriel reported 143 cases operated upon in St. Mark's Hospital, London, by this method during the period from 1910 to 1924. The operability rate was 44 per cent. The primary mortality 15.4 per cent.

The tabulation of cures is as follows:

	3 year cures	5 year cures
Figures based on total number operated.....	23.5% (20 of 85)	24% (15 of 63)
Figures based on survivals	28.5% (20 of 70)	28.0% (15 of 54)

A large number of statistics of end results of the sacral method are available. Most of them are old and many must be corrected to make them justly comparable. These selected series are representative of the best that the sacral method has to offer.

During the development of the sacral method of attacking rectal growths another trend became apparent. In fact, even before Kraske's report, Koenig excised a high lying growth by the combined method, first opening the abdomen, establishing a colostomy and then amputating the bowel from below. His patient died. The operation was performed in 1882, but the case was not published until 1888 by Hildebrand. Czerny, often credited with the first combined operation, dealt, not with a cancer of the rectum, but with a growth of the sigmoid. He attempted extirpation through the perineum, but finding this impossible he opened the abdomen, resected the growth and made an anastomosis. His patient also died. The case was not published until 1893 and in reality is not entitled to credit as a combined operation for cancer of the rectum.

Gaudier, of Lille, in November, 1895, and Chalot, in December, 1895, carried out combined operations beginning with laparotomy. Both established an abdominal anus and mobilized the pelvic colon in the first stage. Chalot in addition tied the superior hemorrhoidal artery within the abdomen in order to control hemorrhage during the perineal stage. Both operations were completed in one seance and both patients perished. Gaudier's case died on the fifth day, apparently of pneumonia, and Chalot's case, of renal insufficiency. In August, 1896, Gaudier successfully operated by the combined method upon a woman aged thirty-five. She lived eight months and died of recurrence.

The next operative success was that of Boeckel in November, 1896. He began the operation as a Kraske and found it impossible to complete it from below. He therefore opened the abdomen, divided the colon, made an iliac anus, liberated the lower segment and returning to the sacral route, easily completed the removal. To close the defect in the peritoneum he turned the uterus backward and fixed it to the sacrum.

Quénu now made himself the champion of the combined abdomino-perineal type of operation. In October, 1896, he operated successfully upon a woman of fifty years and separated the perineal from the abdominal stage of the operation by an interval of six days. This is the first instance of the two-stage operation which has of late years been extensively employed in various forms. He did much to standardize and popularize the combined operation, and it is generally known by his name. He emphasized the importance of asepsis and good hæmostasis. In order to assure the latter, he advised preliminary ligation of the internal iliac arteries, but this step has now been abandoned in most quarters as unnecessary.

The combined operation became the accepted French method as the sacral procedure was favored in Germany. Kraske in 1900 admitted the utility of preliminary laparotomy in certain cases and a few German surgeons

as Kirschner, Schmieden and Fischer, Hofmeister, Gulecke, Finsterer and a few others have favored the combined operation. The majority led by Hochenegg, Von Eiselsberg, Kulenkampf, Poppert and Clairmont, have stood by the sacral procedure which still remains distinctively the German method. It is true also that a few French surgeons such as Savariaud favor the low approach, but the weight of opinion of such men as Tuffier, Schwartz, Hartmann, Pauchet and Cuneo is for the combined operation with certain exceptions dictated by the age or condition of the patient. In general, therefore, national lines of division still hold in the choice of operation.

England and America have wavered, though tending in general toward the French methods. In England, Miles is the protagonist of the combined method. In America, Blake, Lusk, Tuttle, Jones and Coffey have favored combined excision. Many surgeons both in England and America, however, have continued to practice the sacral operations, particularly those whose work in this field is limited to the occasional case. The Mayo Clinic which formerly practiced both operations with apparent preference for the combined procedure has been strangely silent for a number of years, but from report and personal observations seem to be following the Lockhart-Mummery method at present, which consists of a two-stage operation with exploration and colostomy at the first seance followed in a week or so by perineal excision.

In the presence of such a diversity of opinion and practice, what are we to conclude? First, it is evident that we are not yet oriented and that standardization belongs still to the future. It does not mean, however, that certain principles have not become clear and that the lines of progress have not been forecast. Of what value are statistics? They are of the greatest value in establishing the fact that carcinoma of the rectum is the most amenable to cure of all internal cancers. Many cases are now on record of long survival after removal of undoubted carcinoma. Hochenegg's first case of sacral removal lived thirty-two years and died of intercurrent disease. Blake in 1925 showed two cases alive and well sixteen and seventeen years, respectively, after combined operation. Cripps reported a case surviving over thirty years after an operation which to-day would be considered incomplete. Like instances could be multiplied. No other variety of internal cancer can show comparable figures.

But we are still groping for the best operation.

It is not possible as yet to settle the matter by the statistical method. The reason for this is the complexity of the factors involved. A great cause of erroneous impressions has been the failure to realize fully the extraordinary variability in the degree of malignancy shown by cancer of the rectum. In a considerable percentage the growth proceeds slowly. Permeation is gradual and it has long been a matter of comment that many growths form metastasis late or sometimes never. Among fifty-eight cases dying from cancer of the rectum, Oehler found 34 with no demonstrable internal metastasis. McVay recently restudied this point in 100 cases dead of cancer of the rectum. Fifty-three per cent. showed no involvement of the regional

glands, 30 per cent. slight involvement and 17 per cent. marked involvement. Age seemed to play no noteworthy rôle in the distribution of these groups. It is of interest that the smaller, deeply ulcerating growths furnished a greater proportion of metastasis than larger growths with a tendency to grow into the lumen. The application of these studies to clinical purposes must be made guardedly since it is evident to anyone familiar with such researches that it would be impossible to avoid overlooking minimal metastatic deposits. Still it is significant and quite different from the state of affairs in cancer in most other areas of the body.

In Hochenegg's series 150 patients were treated by colostomy alone. Seventy-two and five-tenths per cent. of these died within a year, but 10 per cent. were still living after two years and 5 per cent. after three years. One case survived twelve and one-half years. In the Breslau clinic reported by Eichhoff 167 patients were subjected to colostomy for inoperable cancer. Sixty-two per cent. died within the first year, 6 per cent. lived longer than three years and three patients died in the seventh year. Wells reported a case which ran for seventeen years from the first operation, having been operated upon three times for local recurrence during that period.

Even more remarkably, Mandl lists among the survivors of operation without demonstrable recurrence or metastasis for five to fourteen years, ten cases in which the growth was not completely removed according to gross and microscopic evidence. Two of these cases were of the colloid variety of carcinoma which, it is well known, are often sluggish, relatively benign growths. Hochenegg, however, has not been able to establish any histologic criteria of the degree of malignancy in his huge series. MacCarty and Kehrer have studied 102 cases dead of recurrence in an attempt to correlate longevity with type. The factors selected to indicate body resistance and growth energy were lymphocytic infiltration, fibrosis, hyalinization and differentiation. They found that where all these factors were present in a growth the average survival was three times as long as when none of the factors was present. In general, however, the study bears out Hochenegg's experience that no histological variety can be regarded as universally benign or malignant but cures and failures are well distributed in all groups.

Lockhart-Mummery has recently laid stress on age as an index of the degree of malignancy. It has long been known that in general, cancer in the young is more rapid in its development and fatal outcome than in advanced years. Phifer, in a collected series established the truth of this idea. Lockhart-Mummery states that he has no record of any patient under thirty years of age treated for cancer of the rectum who has not died from prompt recurrence, no matter how drastic the operation or other treatment had been. He doubts whether it is worth operating on such cases. While admitting the force of this contention, it is worth noting that in the Breslau series of 1021 cases there were forty-five cases under thirty years of whom only thirteen were operable. Two can be considered cures, having survived fifteen and twenty-seven years, respectively. Hochenegg also had an experience

of thirty cases under thirty years and on the basis of several permanent cures advises against absolute pessimism. The great majority of the cases fortunately are in the fourth, fifth, and sixth decades. The youngest patient was reported by Rowntree, aged ten years. Bernouille's was eleven. There are several of twelve years and the age incidence slowly increases up to forty, when it abruptly rises, falling again promptly around seventy.

Sex has no apparent influence on degree of malignancy. Men are subject to this disease more often than women, almost in the ratio of two to one. Pregnancy does not appear to heighten the virulence of the condition. Indeed, Hochenegg's experience has been more favorable in cases discovered during pregnancy. The duration of the growth and its character when first observed may give some indication of its malignancy. Miles came to the conclusion that by the time three-fourths of the circumference of the rectum had been involved, the growth was more than a year old and that penetration of the wall of the bowel occurred before one-half of its circumference was involved. This, like all general statements, is subject to many exceptions. Mention has already been made of the fact that the size of the growth bears no necessary relation to the existence of metastasis outside of the bowel. In fact, the relation is more likely to be inverse. Seeing these patients as we do now, only after well-marked symptoms have been present for some months, a large growth protruding into the lumen is of better prognostic import than a small excavated growth which is more often accompanied by glandular or hepatic metastasis. Perirectal infiltration and fixation of the growth is also not a certain sign of the extent of cancerous infiltration as has been noted by many authors since these conditions may be a result of inflammation secondary to ulceration and infection. Following colostomy and relief of infection, the mass itself may shrink and become movable and favorable for removal.

In the presence of these variables one may well shrink from dogmatism not only in the individual case, but in generalities. Were it possible to obtain criteria of malignancy the immense significance would be apparent in prognosis, the evaluation of reported cures and in the selection of suitable operation. In the absence of such criteria we must recognize this great variability in assessing the results of operation. Such knowledge will serve to minimize the value of isolated instances of survival. I have in mind a personal observation of a woman still living twenty years after a simple Lisfranc operation for a very early cancer of the anal canal, of another case alive and well five years after cauterization of a huge inoperable mass involving the ampulla. Such cases and small series for this reason have little bearing on the problem of the best operation for the greatest number.

It would be logical to suppose that the ideal plan of operation in cancer of the rectum would be the same as that which has yielded the most satisfactory results in the surgery of other varieties of cancer, namely, the widest possible bloc excision of tissue in immediate relation to the growth together with the tissue carrying the regional lymphatic vessels and glands. This ideal of inclusion of the efferent lymphatics has given rise to much research, to

various conclusions and to sharp differences as to the appropriate operation to be employed. The investigations of Mascagni, Sappey, Quénu, Gerota, Boulay, Cuneo and Marcille are well known. Miles in his excellent studies has well summarized the previous work on the lymphatics. He divides them into intramural and extramural systems. The intramural lymphatics are those of the rectal walls and are divided into two chief plexuses, one in the submucous tissue and the other between the two muscular coats. These communicate by short radiating vessels with each other and with the peripheral lymph sinus situated between the rectal wall and the perirectal fat. According to Miles the longitudinal spread in the wall is of very limited extent. Handley, however, maintained that special methods showed in certain cases deposits of cancer cells in the wall of the bowel as far as five inches distant from the growth. His results have been much criticized, but recently Winkler has demonstrated that certain cases undoubtedly do show extensions in the submucosa for a distance of four to six inches and that their extension while usually upward may be in the reverse direction. Sifting the evidence it would seem that in the overwhelming majority of cases, Miles, who merely restated the old conviction, is correct, but that in a small number there is unquestionably a considerable spread in the wall of the bowel itself.

A more complicated problem is presented by the extramural lymphatics. Again quoting Miles, " from the anorectal glands which are scattered over the surface of the rectum, efferent vessels pass in three directions—downward, laterally and upward. Those from the anal canal cross the ischio-rectal fossa, pass through Alcock's canal and terminate in the internal iliac glands. Those from the lower part of the ampulla traverse a plexus situated between the levator ani and the recto-vesical fascia, enter a gland near the obturator vessels and thence pass to the internal iliac glands, whilst those from the upper part of the ampulla accompany the superior hemorrhoidal vessels behind the rectum to enter the retro-rectal glands from whence they proceed along the line of origin of the pelvic mesocolon to the glands grouped at the origin of the left common iliac artery. From the uppermost ano-rectal glands also lymph-vessels pass to the paracolic glands situated along the mesenteric border of the pelvic colon." From this description he proceeds to define these zones of spread with the anatomical structures involved. (1) The zone of downward spread including the peri-anal skin, the ischio-rectal fat and the external sphincter muscle; (2) the zone of lateral spread comprising the levator ani muscle, the retro-rectal lymph-nodes, the internal iliac glands, the base of the broad ligament; (3) the zone of upward spread, which he considers the most important of the three, embracing the pelvic mesocolon and adjacent parietal peritoneum, the paracolic lymph-glands and the groups of glands situated at the bifurcation of the left common iliac artery. Upon this anatomical foundation Miles postulates his ideal operation, a combined operation beginning with laparotomy in order to deal with the zone of upward spread, intra-abdominal liberation of this entire area and the greater portion of the zone of lateral spread, the establishment of an abdomi-

nal anus and finally the removal from below of the zone of downward spread and, as the dissections meet, of the mobilized portions above. It is a beautifully conceived procedure developed after the idea of the French school led by Quénu and Hartmann. Unfortunately he does not give his figures of operability which plays such a rôle in mortality, but the death rate is high as follows (reported in 1920):

	Operation mortality	
First series	42 cases	40%
Second series	19 cases	26.3%
Third series	11 cases	18.1%

Owing to the war seventeen of the forty-eight patients who survived the operation could not be traced. Sixteen were alive and well for periods varying from six to eleven years. Percentage of cures by total operations, 21.4 per cent.; by survivals, 33.3 per cent. In the face of these excellent results the serious and valid criticism of Miles' operation was its high mortality. In the hands of those who attempted the procedure with less experience, it showed an immediate mortality of not less than 50 per cent. It is impossible to popularize such a deadly form of treatment. It is worth noting here that the data used by Miles in working out his zones of spread along the lymphatic efferents have been modified and extended in some respects by recent researches of Villemin, Huard and Montagnè (1925). They have shown that each of the parts of the rectum corresponds to a distinct lymphatic territory having its own collectors and that these collectors can be divided into two groups independent, the one from the other. Owing to the surgical significance of this observation they recommend abandoning the old anatomical division of the rectum for a simpler division on the basis of lymphatic distribution. The lowest value of Houston is at the level of the cul-de-sac. Above this the rectum is partly covered with peritoneum and is to be known as the pelvic or upper rectum (haut rectum). Below the valve is the perineal or lower rectum (bas rectum). The arteries, veins, lymphatics, and nerves of the upper rectum are all in origin or destiny abdominal. The blood and lymph supply of the lower rectum is mixed in its distribution only the smaller portion being derived from the abdomen, the remainder as also its nerves, coming from without. Lymphatic injections in the lower rectum spread upward to the last valve of Houston, but never beyond, leaving the rectum at that level. Injections above the valve spread downward but are arrested at the valve. There is no such limitation at the rectosigmoid junction. The lymphatic efferents are divided into three groups corresponding to the three arteries of supply. The superior division following the superior hemorrhoidal vessels reaches the abdominal group of glands. The two divisions corresponding to the inferior and middle hemorrhoidal artery, pass chiefly to the perineal, parietal and pelvic groups of collectors but, important to note, separate channels exist to the inguinal glands and to the intra-abdominal glands. This lower system of collectors therefore is never filled by injections from the upper rectum, but the abdominal glands may be filled

from the lower rectum. Their deduction is that cancer of the upper rectum should be removed by an operation exclusively abdominal; secondly, cancer of the low rectum should be removed by abdomino-perineal operation. In the abdominal stage the ligation of the inferior mesenteric artery should be placed above the origin of the superior left colic artery since trunks are demonstrable leading from the lower rectum directly to the glands at this point. These glands must be considered therefore as part of the first barrage concerning which Cuneo says "as long as this is not passed by the growth, surgical intervention is still possible. This obstacle forced, the dissemination of cancerous elements renders impossible all radical operations." The possible application of these observations must be given serious consideration not only, however, with reference to ultimate cure, but in relation to the question of mortality raised by Miles' statistics of the ideal operation. In the attempt to ameliorate this handicap and retain the advantages of complete excision, several two-stage operations were devised. It has been noted above that Quénu in his first combined operation separated the perineal from the abdominal stage by an interval of six days. Procedures were devised by W. J. Mayo, Dahlgren, Coffey and others. Some of these methods carried the first stage to the point of severing the pelvic colon and its circulation completely from their upper connections, after which the pelvic peritoneum was sutured above these structures which were packed down into the pelvis for removal at the second stage several days later. Coffey attempted to make use of the invagination method by drawing the upper bowel down through the rectum and leaving it for removal later. By whatever procedure this was attempted, however, it was found that gangrene occurred in a large proportion of the cases and a very fatal infection of the huge denuded space resulted with high mortality. Mayo simplified the plan by confining the abdominal procedure to an exploration and a colostomy. Subsequently the rectum was removed with great safety by the sacral route. He later elaborated the intra-abdominal stage by tying the superior hemorrhoidal artery and the vascular arch. In order to avoid gangrene the sides of the pelvis and the middle sacral artery were left untouched. Chalot had tied the superior hemorrhoidal in one of the earliest operations in order to diminish hemorrhage in the second stage which, however, was carried out immediately. Quénu practiced ligation of both internal iliacs. Even with these precautions Mayo had a case of perforation of the bowel due to vascular insufficiency. The difficulties due to circulatory causes had engaged the attention of the Germans, especially in their desire to preserve the function of the sphincter. Gangrene of the segment of the bowel brought down to the perineum was frequent and failure of anastomosis in part at least was the rule. Infection of the pelvic space or peritonitis largely due to this complication furnished the greater part of the immediate mortality. The much quoted research of Sudeck gave the rational explanation. He showed that the superior hemorrhoidal artery is for all purposes an end artery. It is, however, connected at some point with the anastomosing arcade of the descending colon and sig-

moid. It follows therefore that the vitality of the upper rectum will be lost if the superior hemorrhoidal be tied below the point of entrance of the anastomosis with the marginal arcade, but will be maintained if the ligature be applied above that point. This is the so-called critical point. Rubesch pointed out that the important anastomosing branch sometimes enters the left primary branch of the superior hemorrhoidal artery instead of its main trunk. In this case ligation of the hemorrhoidal artery immediately above this point would leave half the upper rectum unsupplied, and the critical point would be above the bifurcation of the superior hemorrhoidal. Whenever in the course of the two-stage operation it is necessary to settle this point, it should be determined by study of the area of anastomosis which varies in individual cases or, in case of difficulty in fatty mesentery or unusual arrangement, the ligation should be made at least as high as the beginning of the superior hemorrhoidal or above the origin of the last sigmoid artery. So far as is known, ligation at the promontory will always conserve the blood supply of the rectum. These observations have been amply confirmed by Rehn, Manasse, Quénu, Archibald and Mondor. The latter objects to the emphasis placed upon the critical point, declaring with truth that a critical area should be considered which includes not only the point of ligation of the artery, but the mesocolon containing the vascular arch. It is obvious that the arch must be respected wherever the ligature be placed, since the nourishment of the bowel then depends on a single source of supply through the mesenteric arcade. In the one-stage amputation it is unnecessary to consider this vascular arrangement, but in the two-stage operation, or in any procedure which aims at restoration of the pelvic rectum or even in the establishment of a sacral anus, it is quite necessary to respect these conditions in order to avoid gangrene in the neighborhood of the rectosigmoid junction. This applies also to any operation which would resect the sigmoid within the abdomen and leave the distal portion as a blind pouch. In order to fulfil the requirements of the combined excision it is necessary to resect at least the lower sigmoid mesentery containing the superior hemorrhoidal artery in order to remove the abdominal lymph vascular tract. It remains to be seen whether this is sufficient in all cases. The studies of the lymphatics above quoted, as also clinical observations of Jones, Moynihan and others, indicate that in some instances at least the section of the blood and lymph supply must be at a higher level. At all events it is a minimum requirement to remove the bifurcation of the superior hemorrhoidal with its neighboring tissues. This is called by Mondor on account of the confluence of the blood and lymph supply at this point, "the hilum of the rectum."

Daniel Fiske Jones in 1915 published his modification of the two-stage abdomino-sacral method which permitted wide removal with great safety. The sigmoid and descending colon are mobilized and the inferior mesenteric tied just below the left colic branch. The peritoneal flaps are reflected from the mesentery of the lower sigmoid and rectum. The whole pelvis is dissected from the promontory above and the ureters laterally. The bladder is

freed anteriorly. The upper rectum and sigmoid are thus detached from their intra-abdominal connections, are held forward, and the peritoneum sutured behind the bowel and close about it. If the sigmoid is to be brought down to the perineum the abdomen is closed. Otherwise an abdominal anus is made high in the sigmoid. A week or so later the coccyx is removed and the perineal amputation or resection completed. Jones has always been reluctant to preserve the sphincter because of the danger of incomplete removal of the disease. In 1922, he was able to report ninety-two abdomino-perineal operations with twenty-three three-year "cures," a percentage by number of operations of 25 per cent. and by survivals of 40 per cent. The mortality in his series was largely in the early cases before the method described had been worked out. He had performed an increasing number in one-stage as familiarity with the procedure increased. In the last eighteen combined operations there had been no immediate mortality. This low mortality was obtained in a group with the operability figure of 60 per cent.

In the same year (1922) Coffey presented a detailed and beautifully illustrated plan of combined operation which has attracted much attention. Impressed with the importance of the upper zone of spread he has adopted the abdominal anus as a routine. Through an abdominal incision the lower sigmoid is detached and together with the upper rectum is completely mobilized. The freed tissue is then disposed of, either by evaginating it through the anus, or by amputating a portion of it if the growth is high, in which case the lower segment is closed and allowed to remain. If evagination cannot be accomplished because of stricture or excessive mass of the liberated tissue, the latter is cut away before the lower segment is inverted and closed. The pelvic peritoneum is then repaired. Drainage of the potentially infected pelvic space is accomplished through the vagina in the female and in the male by placing a large suprapubic drain which is isolated from the abdominal cavity by drawing over it posteriorly the lateral peritoneum from the sides of the pelvis and bladder, thus constructing a tubular drainage area to the surface emerging at the lower angle of the wound. At the second stage the lower rectum is speedily removed through the vagina in the female or the posterior perineum in the male. He reports thirty-seven cases with two deaths (5.4 per cent.). End results are not yet obtainable. If one might venture to predict the outcome, we would prophesy an undue percentage of ultimate failures due to insufficient removal of the downward and lateral zones of spread. However, we believe that the mortality would not be materially increased by wider excision at the second stage, and it is the merit of this operation that it has shown as had Jones that a complete intra-abdominal procedure is not incompatible with low primary mortality.

It is unfortunate that the French surgeons who have been using the combined method for years have not shown equal pains and persistence as the Germans in collecting their end results, but such seems to be the case.

Scarcely a single point of advantage is alleged by advocates of the one type of operation but is resisted by denial or the presentation of offsetting

factors by those in the opposite camp. Perhaps we can best come to some sort of agreement by stating those points concerning which there is almost unanimous consent.

(1) In spite of the many instances of low malignancy and late metastasis observed in cancer of the rectum, permanent cures have increased in number *pari passu* with wider ablation of related tissue.

(2) There is no debate concerning the liability to metastatic involvement of the upward zone of spread in a certain percentage of cases.

(3) From the sole standpoint of cure, therefore, there is excellent reason for including this area in the bloc to be removed.

(4) Complete removal of this area in most cases can be carried out only by the aid of previous intra-abdominal mobilization.

(5) Those who do not practice consistent and complete removal of this zone limit their procedures for other reasons than those which have to do with permanent cure, *e.g.*, mortality, morbidity, wider applicability, less frequent necessity for abdominal anus and a feeling that their results are practically as good.

We have already considered the difficulties of statistical estimate of comparative mortality. In the one-stage operation the danger of shock is undoubtedly greater in the combined than in the sacral operation. On the other hand, the danger of infection immediately subsequent to operation is greater in the latter. Practically all considerations of post-operative deaths in the low operations show that more than half of the fatalities are due to infection of the pelvic space or to peritonitis. To this number might fairly be added a certain proportion of deaths due to vascular, heart and lung complications. Probably not less than 75 per cent. of all deaths are infective. The greater security in aseptic technic by the combined method should and does obviate or mitigate a large proportion of these infections. By the two-stage method infection as a serious factor is largely abolished, whether the operation be of the complete or limited type. Naturally by the limited type in which the abdominal procedure is practically only a colostomy, the mortality is lower. This is Lockhart-Mummery's platform and restricts the argument to the actual advantage to be derived from the more complete operation which must wait on further experience. There is no question, however, even in Lockhart-Mummery's mind, that if the complete procedure could be performed with equal safety the end results would be superior. If it be objected that Miles' present mortality of 18 per cent. is too high, it suffers little by comparison with the mortality of the foremost German surgeons performing the radical sacral operation and is lower than that of many. Also the lowest mortalities achieved in any reasonably large series are those of Coffey and Jones who employ the combined method. It seems clear that the attainment of a low mortality by the combined method rests (1) on the use of a rational, well-standardized method and sufficient experience to carry it through without unnecessary delay or avoidable accident and (2) on the exclusion of those cases who would be unsuitable for any severe procedure whether by reason of

age, obesity or debilitated condition. To overload the operation with those who cannot endure it and to deny those who can endure it, the added security which it affords is equally unwise.

The morbidity of the complete operation, whether combined or sacral, is high owing to the large pelvic space which does not permit of healing by first intention. Here the advantage is distinctly with the two-stage operations on account of greater freedom from severe primary infection.

It is unnecessary to review to a surgical audience the question of colostomy. By all except the German surgeons it has been decided that an abdominal anus is preferable to an uncontrolled sacral opening. The preservation of the sphincter is not a point of contest between the two types of operations since the continuity can be restored equally well, if not more safely, by a previous abdominal mobilization as by the sacral route. It is true, however, that most surgeons who are sufficiently impressed with the necessity for wide excision to prefer the combined method are rarely willing to preserve the sphincter with its essential surrounding tissue and nerves, because of the danger of recurrence.

The permanent results of the newer operations must wait. I regret that my own cases are too few and recent to add. Enough is known to warrant the belief that the percentage of cures will be increased. Certainly wider excision could not decrease the prospect of cure. It is our belief that the radical combined operation will win the day and that the perineal or sacral operations will be restricted to cases unable to endure the more exacting procedure.

Körte stated that this operation is the most difficult in surgery. Chalier and Mondor reply that it is only necessary to learn it.

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ASEPTIC TECHNIC OF STOMACH RESECTIONS

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In the majority of operations pertaining to modern gastro-intestinal surgery the temporary opening of the organs involved is unavoidable so that it depends on the surgeon's skill only how to evade the soiling of the wound and abdominal cavity by the infected contents of the organs in question. How to close the wide temporary openings caused by the resection lines, quickly, safely and in an aseptic way, stopping hemorrhage at the very same time as well, is a question which has been much discussed ever since the beginning of modern abdominal surgery.

By the method of Doyen—*i.e.*, the crushing of the bowel wall by means of a crushing-forceps, double ligation in the crush furrow and division in the middle, followed by a purse-string suture—the quick and aseptic closure of a normal jejunum, for instance, is a very easy task even for the beginner, but this reliable method of Doyen cannot be used on the stomach, nor in many cases on the colon and is useless in some cases of intestinal obstruction also, as we usually find the oral loop of the strangulated bowel greatly dilated much beyond its normal size.

In these cases we used to close first provisionally the organ in question by means of a forceps or crushing clamp—such as, for instance, Kocher's Graser's, Payr's, etc., and then complete an exact hand-made suture close behind, or in the narrow sewing-slit of the clamp in question. After that removing the instrument and finishing the definitive closure by one or two rows of continuous sero-serous sutures. This way of closing is neither quick, nor aseptic enough and requires much skill and practice from the surgeon.

As for the lack of rapidity of this method, I have only to point to the enormous technical difficulties attending the closure of a retracted cardial stomach-stump after a subtotal resection because of advanced cancer, where the provisional closure must be done in a deep and in a hidden place, sometimes hardly accessible even for the surgeon's hands. These technical difficulties may suggest to the surgeon to proceed in a less radical way than is necessary.

As for the asepsis of such a procedure, we cannot consider it aseptic at all, simply because the thread has to pass many times through all tissues and through the infected contents of the organ as well and becomes thoroughly soiled by different germs after the very first of the stitches.

How serious the consequences of such soiling of the operation-field with germs of this said origin may be are shown by the words of *Kelling*: "As for the mortality rate incident to stomach resections I have come to the opinion, that the most of them: such as the sepsis, pneumonia, gangrene of the lungs, the local and general peritonitis and none the less the leakage of our

sutures also, are due to *one* reason in general: to the soiling of the tissues (peritoneum, mesentery, stomach-cut, etc.) by the infected contents of the cancerous stomach."

It is a matter of course that when doing a suture the hands of the surgeon and none the less the operating field, should be kept clean from being soiled with the utmost carefulness. Easy to say—but very often impossible to do it!

In many cases of stomach and of other resections, the mobilization of the organ in question is a simple task, and it is the easier for the surgeon to avoid infection, the better he can lift the object of his operation above the abdominal wall of the patient, but as a rule—and especially when resecting a stomach with advanced cancer—the greatest difficulties may be met with and we are forced to complete the provisional closure of this organ, usually much retracted underneath the thorax, where there is but a very little room for the surgeon's hands, and no room at all for protection with sterilized gauze-towels. The large number of different stomach-clamps is the best proof of the fact that the surgical-technical part of this question has suffered from more than one weak point. To mention the most used types only: amongst the clamps of *Kocher, Graser, Payr, Lanz, Bakes, Gosset, Gelinsky, Marro, Moynihan, de Quervain-Graser, Lane, Alwin Ach, Scudder,* etc., we may observe a certain advance inasmuch only, that instead of the flexible forceps of the earlier periods more rigid crushing-clamps have won popularity everywhere, some of which are combined with narrow sewing-slits also.

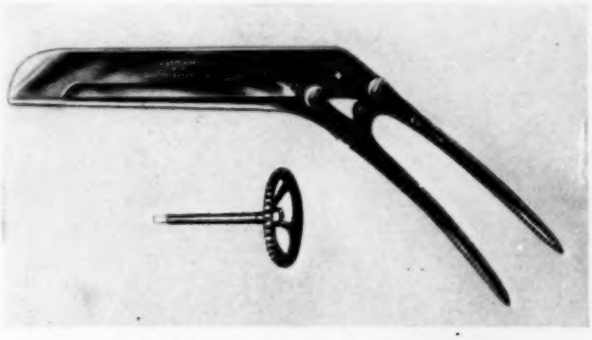

FIG. 1.—Stitching forceps and removable handle.

To make provisional closure easier, quicker and more aseptic, two different kinds of mechanical contrivances have been brought to the market: the stitching instrument of *Florian Hahn* and the ponderous and complicated stitching forceps of *Hültl-Fischer.*

From the practical point of view none of these stitching mechanisms was able to supplant the old hand method. Although I have personally more than once experienced the imperfection, unreliability and clumsiness of both these instruments, nevertheless by the fact, that the hand-made closure can be considered neither quick, aseptic, nor reliable enough, I have been led to create an instrument more fully corresponding to all demands. (Figs. 1 and 2.)

This instrument is simple, reliable, aseptic, saves much time, and simplifies resections to a marked extent. Even the most skilful of surgeons needs ten or fifteen minutes at least to complete an exact provisional closure of the

newly formed stomach-end when resecting this organ. By means of the instrument presented, the same task is done in half the time, because the instrument is completing two rows of sutures at the very same time!—and the whole procedure does not require more than ten seconds altogether!

After having gently pressed the contents of the stomach toward the pylorus, one closes the instrument at the very point of the organ where we want to perform resection-line, and after having adapted the removable handle, we turn it three times, then remove it, and remove the opened clamp also.

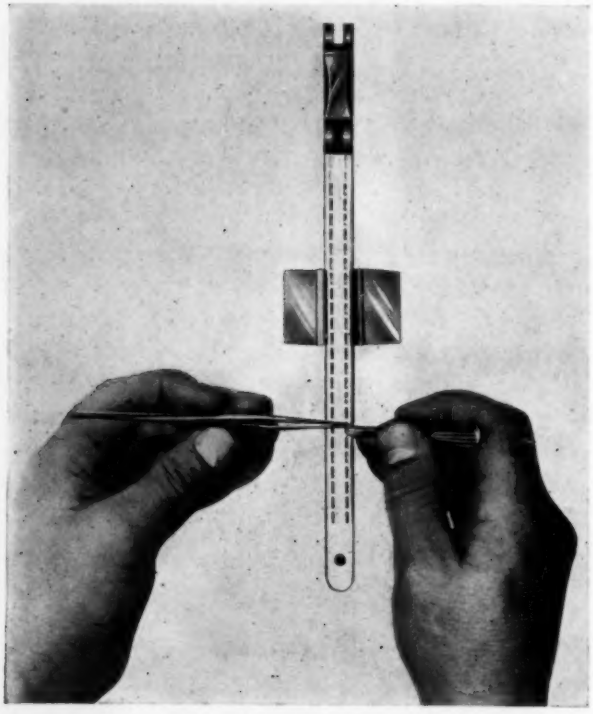

FIG. 2.—Filling up the stitching forceps. The removable upper part is placed at the container and the fine U-shaped new-silver hooks are pushed one after another in the holes of the clamp by means of a pincett and filling pin.

In its shape and size this stitching clamp is but slightly larger than the ordinary stomach crushing clamp of Payr, only there is this difference that in the upper part of the forceps I have placed an absolutely simple and reliable stitching mechanism, which, by turning three times the removable handle makes two perfect and straight rows of fine new-silver hook-stitches at the very same time, situated at both sides of the crushed furrow. Thus the line of resection is closed within a few seconds in an aseptic and water-tight way toward the oral, as well as toward the aboral side. (Fig. 3.)

The crushed furrow situated between the two parallel rows of these new-silver hook-stitches is a quarter of an inch wide, and is large enough for the simple division with a straight scissors in the middle.

The fine U-shaped new-silver hooks pressed in the stomach wall, and covered by an inverting suture, have no dangerous consequences at all. X-ray examinations have repeatedly shown that within two to three weeks they fall into the cavity of the organ. As they are round and cannot stick to the mucous membrane of the digestive tube, they are emptied with the stool of the patient, like the anastomosis button of Murphy.

Filling and Sterilizing the Stitching Instrument.—The filling of the stitching clamp with the small U-shaped new-silver hooks is a task of six or seven minutes only and should be done by the nurse before operation. For

this purpose the upper part of the clamp must be removed by the simple way of unscrewing two hand-screws, and at the small container, which is attached to every instrument placed. The fine U-shaped hooks are pushed one after another in the holes of the clamp by means of a pincett and a filling-pin as demonstrated in Fig. 2.

To prevent mistakes when filling the instrument, such as to miss one hole or to put two hooks in one and the same hole, it is best to place the filling pin in the very next of holes we wish to fill, while the pincett in our left hand is picking up the next hook from the box. The hooks should be pushed so deep in the holes, that their pointed ends just disappear. Each of the two hook rows is composed of twenty-three hook-holes, giving a length to the crushing surface of five and a half inches. This is large enough for the most dilated stomach.

FIG. 3.—Two rows of new-silver hook-stitches at both sides of the crushing furrow of the stomach. The line of resection (marked by arrows) is closed in a quick, aseptic and water-tight way toward the oral, as well as toward the aboral side. The crushing furrow must be simply divided in the middle with a straight scissors.

As for the sterilization of the stitching-clamp, it is not different in any respects from the sterilization of other surgical instruments. It should be boiled with the other instruments when filled. To warrant an unlimited durability to this instrument, made out of hand-forged non-rusting steel, nothing else is required than to clean it with a nail brush and petroleum and to dry it.

When Can the Stitching Instrument be Used?—The instrument can be used in all cases of stomach and colon resections without regard to the kind of anastomosis following. It may be used as well in the case of a side-to-side as in the case of an end-to-side and none the less in the case of an end-to-end anastomosis, which circumstance simplifies the sleeve-resection of the stomach, for instance, to a very considerable extent.

As for my part I used to prefer the original Billroth No. 2 stomach resection method, completely closing the newly formed proximal end of the stomach and making a posterior gastrojejunostomy.

Polya's and Mayo's modification I am following only, when because of extensive retrogastric adhesions or because of the subtotal resection of the stomach—in cases of advanced cancer—there is no room at the retracted back wall to complete an anastomosis large enough.

In these cases after having completed the provisional closure of the resection line by means of the stitching instrument and having dissected the

crush furrow between the lines of hooks and after the first row of sero-serous continuous silk sutures, begun at the lesser curvature, has united the back wall of the stomach for half an inch behind the hooks and corresponding loop of jejunum, I used to cut away a certain number of the hooks with a small portion of the newly formed stomach-end in a length slightly longer than the diameter of the jejunum and as wide as a quarter of an inch only.

In the cases of Polya's modification the hooks of the middle portion of the newly formed stomach-end must be cut away and in the cases of Mayo's modification those next to the lesser curvature are to be removed by means of a curved scissors. The rest of the hooks are first covered by three or four inverting silk sutures and then by a continuous inturning silk suture, begun at the greater curvature if we are using Mayo's modification and begun at both curvatures if we are following Polya's modification.

The jejunum is now opened opposite to this point, a half of an inch from the first suture line and the ordinary technic is completed. The opening being closed, the very first sero-serous silk suture is continued over the anterior portion, protecting still further the closed end of the stomach by suturing over it the unopened bowel.

For the last four years I have been using the stitching clamp in all of my cases of stomach resection. Based upon my good experiences with respect to the immediate and after results, I have found no reason for returning to the imperfect hand-made way of provisional closure, the less, because by means of my stitching clamp the completed operation can be made within half an hour and we all know of what importance the abbreviation of the operation must be considered in abdominal surgery.

Those surgeons especially, who are following the radical standpoint of *Perthes* in the much discussed question of simultaneous stomach-colon resection (resection " en bloc ") in the desperate cases of unseparable adhesions between stomach and transverse colon and in the cases of propagation of the cancer at the transverse mesocolon, will find a very useful instrument in these stitching clamps. For this kind of " en bloc " resection two pairs of stitching clamps are required.

During the last four years I have had two cases among my operations for stomach cancer, which have forced me to make a simultaneous resection of the transverse colon also and both of these patients recovered from the operation. This is a most satisfactory result if we take into consideration, that the mortality rate incident to this radical kind of operation is characterized by more than one prominent surgeon as " frightfully high."

PERFORATED ULCERS OF THE DUODENUM*

A STUDY OF TWENTY-SEVEN CASES

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In 1921 the writer presented before the Surgical Section of the New York Academy of Medicine, fifteen cases of acute perforation of the duodenum by ulcers. Simple closure of the perforation by inversion, with or without omental reinforcement, was advocated as the procedure of choice. A concomitant posterior gastro-jejunostomy seemed indicated in but a small minority of cases.

Since the presentation of these cases the writer has accumulated the personal experience of twelve more cases. The results obtained in these added cases substantiate the advisability of simple closure in most cases.

Before considering these supplementary cases and reviewing those previously presented, it must be emphasized that perforation by duodenal ulcer only is under consideration and pre-pyloric lesions are excluded.

In this most dramatic of acute abdominal crises, operation within the first twelve hours with simple closure of the perforation will terminate in recovery in the vast majority of cases. The question is whether such ulcers are cured by simple inversion closure and if the patients remain well and asymptomatic.

In the light of the experience gained by the twenty-seven cases enumerated the writer proposes to discuss the operative procedure that seems to offer the best—not only immediate, but end results.

But before doing so a better understanding can be had if some anatomic relations and physiologic functions of the duodenum are briefly reviewed.

The cardiac orifice and the first part of the duodenum are fixed parts of the stomach. When empty the stomach lies transversely in the upper abdomen; but when filled it assumes a vertical shape which is due to the descent of the prepyloric part. In accord with gravity therefore, the weight-bearing part of the viscus is in the distal part of the pylorus and that part of the duodenum adjacent thereto. This pendant portion of the stomach, which includes the pylorus, the first part of the duodenum, and the distal part of the lesser curvature has a blood supply that is considerably less than the stomach proper. Also in addition to this subvascularization the mucosa is here intimately attached to the muscle layers forming rugæ.

These peculiarities of anatomic detail allow very little dilatation or contraction and the consequent rigidity predisposes more or less to traction anæmia. The anæmia peculiar to this locale lasts about two hours after

* Read before the Surgical Section of the New York Academy of Medicine, May 6, 1927.

eating and may be regarded as a potent predisposing factor for selective embolic infections, thrombosis or tissue digestion. This anæmia also influences the healing of ulcers occurring in this area subsequent to operative interference. For that reason by raising the foot of the bed about six inches the gravity change thus brought about will overcome this traction and the blood supply will be materially increased.

In the process of digestion, when food enters the stomach, it becomes liquified and mixed with the gastric juice and the sphincter at the pyloric extremity does not relax until chymification is complete. The balance between the motile powers of the stomach, as shown by the retention of its contents and their later propulsion through the orifice of pylorus, is properly maintained. These motile powers are probably segmental in each curvature.

This motility mechanism, however, is badly deranged by gastro-enterostomy. Normally the acidic chyme when it flows into the duodenum transforms the prosecretin into secretin and thus establishes pancreatic secretion. The churning movement of the duodenum intimately mixes the chymified food with the bile and pancreatic ferments and then passes it into the jejunum. Gastro-enterostomized patients are subject to a change that may be termed revolutionary in so far as the physiology of their digestion is concerned.

Gastric contents that are improperly prepared enter the jejunum which in consequence must do the work of the duodenum, a part of the process of digestion for which it has no physiologic fitness. The subjective and objective sequences of this digestive dysfunction may be pain, vomiting, diarrhœa—in fact, the whole gamut of dyspeptic signs and symptoms. That many of these patients thrive despite this handicap only shows the adaptability of the human economy.

It is nevertheless true that gastro-enterostomy performed for the purpose of relieving scar tissue obstructing the pyloroduodenal orifice is, in the majority of cases an entirely satisfactory procedure.

In such cases of obstruction there has existed for some time an altered function, both motile and secretory; mostly of the stomach, to a less degree of the duodenum. For that reason, one chooses the lesser of two evils and makes a short circuit, trusting to Nature's well-known tendency to establish a satisfactory balance.

Conversely, it is well known that in the absence of true pyloroduodenal stenosis, gastrojejunostomy is often fraught with future disaster. For several months the patient is likely to be comparatively free from symptoms, but later results may be most disappointing.

The cardinal indication, therefore, for gastro-jejunostomy would be actual or organic stenosis.

This form of stenosis did not obtain in the majority of the cases cited here, and from discussion with colleagues the impression would seem to prevail that in relatively few perforations from duodenal ulcer does real stenosis occur.

Moreover it must be remembered that nature overcomes many apparent

stenoses. This fact is well demonstrated in three cases, which were subsequently operated upon for (a) incisional hernia; (b) acute suppurative cholecystitis; (c) gastro-jejuno-colic fistula.

The duodenum in all three cases was restored to normal yet apparent stenoses presented at the time of perforation and in one case it was so pronounced that a primary gastro-jejunostomy was added. The evidence in these three cases was convincing testimony of how completely restored to normal the diseased duodenum may become. Not only was there no evidence of scarring, but practically none of adhesions. The writer is of the impression that should the diameter of the duodenum be reduced not more than one-half, due to the infolding of the perforation, no stenosis will obtain.

Pathology: Of the well-established, easily demonstrable chronic ulcer we have ample knowledge; of the so-called acute ulcer, the erosion, the ulcerating lesions which recover and disappear under medical treatment, our knowledge is meagre. It is highly probable that from time to time small defects occur in the gastric and duodenal mucosa, with or without symptoms, and that these spontaneously disappear. Defects of greater magnitude, true ulcers with typical clinical findings, sometimes completely disappear under medical treatment. The so-called remissions and exacerbations in these histories may be explained upon the ground of recurring new ulcers. Once the lesion has become a well-established indurated type the pathological process is prone to become progressive with little or no remission of symptoms. These true surgical ulcers present five general types:

(1) The large ulcer with much scar tissue formation encroaching upon the lumen of the duodenum and accompanied with more or less extensive extrinsic adhesions.

(2) The medium-sized ulcer with moderate scar-tissue infiltration, without narrowing of the lumen.

(3) The small ulcer with a non-indurated or only slightly indurated base.

(4) The actual necrotic ulcer.

(5) Multiple ulcers, including the so-called "kissing" type.

Perforation may occur in any of these, and as the pathology is varied so also are the indications for surgical repair. To dogmatically state that suture with posterior gastro-enterostomy should be employed in every instance is as illogical as to assert that simple closure will always suffice. Good surgery aims to cure the patient with the least insult to anatomic and physiologic function.

Clinically most acute duodenal perforations are those of types 2, 3 and 4. There is a remarkable monotony of appearance to these lesions. They are simple, single, round, slightly indurated, 1 to 2 centimetres in diameter, on the suprapapillary part of the duodenum (the proportion is 450 to 1) and nearly always in the first 1½ inches of the anterior or superior surface. Those occurring at the junction of the pylorus and duodenum are probably for the most part duodenal. In these the pyloric veins are often obliterated. Much less than half of those ulcers present adhesions to neighboring structures;

the gall-bladder, liver, colon, stomach and omentum. Most ulcers that perforate suddenly are non-adherent to adjacent viscera, and when adhesions are present in such they are almost invariably of recent origin. Disease of the appendix and gall-bladder is a frequent concomitant.

The perforation is usually from two to five millimetres in diameter, a typically punched-out hole in the crater of the ulcer. If carefully examined it will be noted that the entire ulcerating portion is extruded as the result of embolism or thrombosis. The remaining peripheral induration is the protective zone that accounts for the rapid healing of the lesion after closure. The writer believes that in many cases this induration is soon absorbed and the duodenum is restored to its normal condition without any macroscopic evidence of previous disease. Thus one seems justified in stating that lesions of types 2, 3 and 4 which form the majority of duodenal perforations are best treated by simple closure.

The large ulcer with an abundance of scar-tissue induration which encroaches upon the lumen of the duodenum and which usually is adherent to neighboring organs, presents a different pathology and demands appropriate surgical therapy. Such lesions, prior to perforation, have produced a partial stenosis thereby resulting in a change in the motile and secretory functions of the stomach. The closure of these ulcers after perforation usually produces a real rather than an apparent obstruction. Consequently they present the cardinal indications for gastro-enterostomy, namely, stenosis plus a preëxisting altered gastric function. (Perhaps some form of pyloroplasty of the Finney or Horsley type may prove efficacious in the therapy of these types.) Furthermore, simple closure in this type seldom results in permanent cure, and the relapses after such a closure have helped to popularize primary gastro-enterostomy for all types. The treatment of the multiple ulcer type must be governed by the pathological problem at hand.

From the above-mentioned pathology, it will be noted that for practical purposes perforated ulcers of the duodenum conform themselves to one of two types. First, the soft lesions—the more common type—characterized, (a) by their relatively smaller size, (b) by their superficial extent, (c) by their failure to penetrate deeply prior to the embolic or thrombotic phenomenon which results in perforation, (d) by the absence of dense induration, and (e) by lack of adhesions and encroachment upon neighboring structures. Second, the calloused type, characterized (a) by their large size, (b) by their deep penetration, (c) by their dense induration, (d) by their firm adhesions to neighboring structures, and (e) by their tendency to produce mechanical complications. The writer believes that simple closure by inversion with fine chromic catgut will cure the vast majority of the first group, whereas the calloused types require in addition a primary gastro-enterostomy (or perhaps some form of pyloroplasty). The successes and failures in this series are in accord with these general principles.

The diagnosis of perforation can be easily made in most all cases. The anamnesis of previous indigestion, the suddenness of onset, the agonizing

pain, constant in character in contradistinction to the colic-like pain of appendicitis, cholecystitis, intestinal obstruction or renal colic; the vast extent and the degree of rigidity and tenderness so soon after onset, the comparatively slow pulse, slight or no febrile reaction is a familiar picture. A few points are worthy of emphasis; vomiting occurred in less than half of the cases in this series (12 cases). Rectal examination may elicit extreme tenderness soon after perforation much earlier than in appendicitis. The symptom of shock has been overemphasized. In this series but 7 were in any degree of shock. Apparently shock, when present, occurs soon after perforation, and is transitory. It should also be mentioned that in stout individuals there is only moderate rigidity. Also in the transitional period passing on to true peritonitis, there is a free interval when the pain is ameliorated. One patient (Case III) seen eighteen hours after perforation sat up in bed exclaiming, "He felt quite well." No opiate had been administered. His abdominal cavity contained the usual amount of duodenal contents and the peritoneum was markedly injected. More than half the cases show obliteration of liver dulness either partial or complete. It is merely a corroborative sign and is in no wise pathognomonic. The left shoulder pain, mentioned as occasionally occurring early after perforation, is probably a pneumogastric-spinal accessory reflex rather than pain of peritoneal or anginal origin.

In the preperforative irritation stage, physical examination may reveal acute tenderness over the ulcer with some rigidity of the overlying muscles. This connotes a deep ulcer with peritoneal irritation and should be an indication for surgical intervention. (Case VII well illustrates this danger signal: The patient, a female of fifty-seven years, for six months had typical hunger pains occurring three hours after eating. Her examination elicited acute tenderness over the site of the pylorus and moderate rigidity of the rectus. Temperature, pulse and blood count were normal. She was put to bed and placed upon Lenhartz diet. Tenderness and muscle spasm persisted. On the eleventh day of treatment, perforation occurred suddenly while she was at absolute rest.)

Treatment of Acute Perforations.—The treatment of acute perforation is immediate operation regardless of any degree of shock that may be present—as the patient's condition rapidly improves with the relief of intraperitoneal tension. A four-inch mid-right rectus incision is deepened down to the peritoneum. A point of practical importance is to determine the lower border of the liver. This should limit the upper angle of the incision. If a small nick be first made into the peritoneum, a little free fluid will well up into the incision, and gas bubbles erupting through this will clinch the diagnosis of perforation. The escaped contents are best aspirated, especial attention being paid to Morrison's space, the right lumbar gutter, and to the toilet of the pelvis. With moist pads the surrounding structures are gently pushed aside and the perforation sought. Fibrin deposits are an excellent guide to the point of perforation and not infrequently gas bubbles point out the way. If the perforation is obscure, slight pressure on the stomach may cause bubbles

to appear. Closure of the perforation is accomplished by infolding the ulcer with fine chromic catgut reinforced occasionally with an omental tab. The expediency of a primary, gastro-jejunostomy is determined by the pathology. If simple closure is performed, one tests the patency of the lumen of the gut. If the tip of the little finger can be insinuated through the site of closure, there is little danger of obstruction. One then makes a search for secondary ulcers, gall-bladder and appendiceal disease.

The added risk of primary gastro-enterostomy, before the advent of peritonitis, is slight in a patient whose condition during operation, as regards respiration, aeration, and circulation, is good. The danger of working in a potentially infectious field is more theoretical than real. The real dangers are two-fold: (1) a 2 to 3 per cent. chance of future gastro-jejunal ulcer formation, and, (2) the late secondary sequelæ which occur in some cases despite perfect technic in the hands of the most skilful. Therefore, unless the pathology is such as to demand a primary gastro-enterostomy, *i.e.*, definite obstruction, simple closure should be performed. A good practical rule is, when in doubt, do not perform a gastro-enterostomy. It can be performed later, if necessary.

If a careful peritoneal toilet be made by aspiration, there is no need of drainage except to the mural tissues. The suprapubic stab wound seldom drains, but may produce adhesions and is contra-indicated. Drainage to the site of closure is never instituted as several duodenal fistulæ have resulted thereby. The slow perforations with abscess formation are best treated by simple incision and drainage. If a fistula ensues, a secondary closure with gastro-enterostomy is indicated.

Following operation the patient is placed in a semi-recumbent position, given one or two doses of morphine and a 5 per cent. glucose rectal drip. Small amounts of water by mouth are permitted after four hours. On the third day, Lenhartz's diet is instituted and adhered to for its entire course. At this time, the foot of the bed is kept elevated about six inches. Frequently small amounts of alkalies are administered the first two weeks. The patient is then given a light, selected, non-bulky diet with crackers and milk between meals for the next two weeks. At the end of the month a röntgenologic examination is made. The patient is warned of the dangers of dietary indiscretions and receives medical supervision for at least six months.

This series is comprised of consecutive cases operated upon between October, 1912, and October, 1926. There were 25 males and 2 females; the youngest patient was twenty-one years, the oldest fifty-seven; the average age was thirty-five years. It is interesting to note that no case was obese (*versus* gall-bladder type) and that several of the patients had been under rather severe mental or physical strain for some period of time. Their occupations were varied, no one predominating.

Seventeen patients, 63 per cent., gave a typical previous ulcer history varying from a few months to eleven years. Eight, 30 per cent., presented an indefinite history of dyspepsia. In two cases there were no symptoms up

to the moment of perforation. (In these the evidence of inflammation and repair were absent and the picture was one of focal necrosis.)

But two cases gave a history of melæna, none of hæmatemesis. Only three cases perforated within the first year of symptoms and the average duration of symptoms until perforation was almost four years.

Of the twenty-seven perforations twenty-four were acute and three slow perforations. Of the slow perforations one presented a large abscess extending from the liver to the iliac crest. This was of two weeks' duration, Another case slowly perforated and remained localized. The third case ruptured into the lesser sac, presenting the clinical picture of duct obstruction with jaundice.

Of the acute perforation (24) the shortest time elapsed after perforation until operation was three hours, the longest twenty-six hours, the average time being ten and a half hours. The average temperature was 99.8 per rectum, pulse 88, respirations 25, white blood-cells 15,400 with 84 per cent. polymorphonuclears. Cultures taken in fourteen cases were all sterile. Of the twenty-four acute perforations a correct pre-operative diagnosis was made in twenty-two. One was thought to be a ruptured appendix, one acute hemorrhagic pancreatitis because of the pronounced shock, persistent vomiting and only slight rigidity. Of the twenty-four acute perforations the soft ulcer type prevailed in seventeen cases (70 per cent.) and the calloused ulcer in seven (30 per cent.). Two of the soft ulcers were of the acute necrotic type and were asymptomatic prior to perforation. In all seventeen cases of soft ulcer simple closure was performed. Of the seven indurated type ulcers primary gastro-enterostomy was performed in five cases and secondarily within one month of simple closure in two others. Five cases had concomitant appendectomies performed at the primary operation and two cases, cholecystectomy.

The immediate results in all twenty-seven cases were good save one patient, simple closure, who suddenly died on the fifth day apparently of pulmonary embolism, giving a mortality of 3.7 per cent. One patient in whom a transverse incision was employed returned in three months suffering from an incisional hernia. During repair, the duodenum was carefully searched for the old ulcer site, it had been a soft ulcer type of one year's duration. The duodenum appeared normal. Another developed an acute suppurative cholecystitis requiring cholecystectomy. The duodenum was free of adhesions and the ulcer site had disappeared.

A third case upon whom a primary gastro-jejunostomy was performed, also cholecystectomy and appendectomy, remained well for four and one-half years. He then suddenly developed a gastro-jejuno-colic fistula with the classical syndrome of left-sided epigastric pain radiating to the left groin, ten to twenty daily watery movements containing large amounts of undigested food and a loss of forty-four pounds in weight.

An operation there presented a gastro-jejunal-colic fistula about 2 cm. in diameter. The remarkable feature was the almost negligible pathology at

the former duodenal ulcer site. There was no scarring, no induration, no stenosis and few adhesions. The procedure consisted in undoing the gastro-enterostomy, closing the gastric and colic atria and resecting three inches of the jejunum with lateral anastomosis. The patient was discharged on the sixteenth day. His weight has rapidly increased and to date he is asymptomatic.

These three cases are presumptive evidence that perforation tends to cure the ulcers and that the duodenum is capable of complete restitution to normal even though an apparent or real stenosis obtains after closure.

The average time elapsed since operation is five years and two months, the longest period fourteen years, the shortest eight months. Seventeen patients have recently been heard from. Twelve had simple closure—of these ten are entirely well (83 per cent.). One required a secondary gastro-jejunostomy two years later for hemorrhage, the other has heartburn and flatulence; his gastro-intestinal series is negative. The known end results of five gastro-enterostomized patients is as follows: Two are quite well (40 per cent.), one has dragging epigastric pain with occasional attacks of diarrhœa. His general nutrition is satisfactory; one required a secondary operation for intestinal obstruction from bands about the appendectomy site and another has had the gastro-enterostomy undone for gastro-jejuno-colic fistula.

In conclusion one seems justified in emphasizing the importance of reporting the end results of the treatment of perforated ulcers of the stomach and duodenum as separate entities. The immediate results depend chiefly upon the time interval that has elapsed after perforation. Only by careful follow-up records extending over long periods can reliable statistics be obtained as to ultimate cures. Undoubtedly the duodenum is capable of complete restitution to normal even though apparent or mild degree of real stenosis obtains after closure. The end results of simple closure in this series are much superior to those treated by gastro-jejunostomy. A fuller appreciation of the pathological problem presented in each case should result in more rational methods of treatment. To state dogmatically that all cases treated by simple closure will result in permanent cure is as illogical as to insist upon a primary gastro-jejunostomy as a universal procedure.

THE INTERPOSITION OF SMALL BOWEL SEGMENTS BETWEEN DIVIDED ENDS OF THE COLON*

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To those who have occasion to resect extensively the pelvic colon, for new growth, diverticulitis, or other lesions, there must often have come the thought of the desirability of uniting the descending colon or stump of the sigmoid with the remaining portion of the rectum—and at the same time an appreciation of how difficult or impossible, in some instances, this may be to accomplish. In the latter part of 1926, the writer was confronted with a specific case, which crystallized this long-considered general problem into a specific demand. As this case initiated the work herewith reported, its general outlines will be related.

The patient had been admitted to the Phipps Psychiatric Clinic of the Johns Hopkins Hospital because of a profound depression. Careful study of the mental status led to the conclusion that the depression was due to a physical disability, which, in turn, was the result of the man's past surgical history. Four years previously, he had undergone a resection of the sigmoid for a lesion which turned out to be diverticulitis. The gap between the sigmoid stump above, and the rectum below, had been considered too great to bring the ends together to anastomose and accordingly, the sigmoid had been brought out and fixed in the midline incision for an artificial anus, and the rectum closed, leaving a short blind pouch below. The patient, after recovery, had resumed his business and social relations, but was much distressed by the incontinent colostomy. This had continued to disturb his mental balance until his depression became, in itself, the major disorder. The psychiatrists believed that if the alimentary tract could be restored to normal, the man's depression would disappear, but that otherwise, there was no method of improving his condition. This, then, was the problem presented to the surgical consultant.

Examination showed a scar from the umbilicus to the symphysis, in the upper part of which was the terminal opening of a loop of bowel. When barium was injected into this opening, and an X-ray plate made, it showed the opening to be the stump of the sigmoid, the rest of the colon being apparently normal. None of the colon below the level of the fourth lumbar vertebra remained. The anus, sphincter muscles, and a short blind pouch of rectum about ten cm. long were discovered on rectal examination. Two plans of operative attack were considered. As first choice, the mobilization of the descending colon and a direct end-to-end anastomosis of the sigmoid to the remnant of the rectum. If this proved not to be practicable, when actually attempted, the possibility was considered of isolating a loop of ileum, and using this as a graft between the sigmoid and rectum, to make good the defect and reëstablish the lumen to the anus. Operation was offered on these plans and was accepted.

As the report of this case is not the primary purpose of this paper, only a few further facts will be related concerning it. At operation, it was found possible, by dividing the peritoneum lateral to the descending colon, to mobilize that structure well up toward the splenic flexure. This permitted the end of the sigmoid to be brought down without tension to the floor of the pelvis. The rectum was opened, and an anastomosis

* Read before the American Surgical Association, May 13, 1927.

made by invagination of the sigmoid, fastened around a rectal tube, into the rectal stump. After a protracted and stormy convalescence, chiefly due to the patient's mental condition, a complete recovery with practical disappearance of the depression resulted. It required a number of weeks for the sphincter to regain its function, which had not been exercised for four years. Before the descending colon was mobilized, it was seen that a loop of ileum could have been utilized without difficulty, to reach from the sigmoid to the rectum; in fact, a loop of ileum was adherent in the pelvis over the closed stump of the rectum.

Although circumstances had not required the employment of a segment of small bowel to connect the divided ends of the large bowel in this specific instance, situations in which this procedure might be of the greatest advantage are easily imagined, and it was thought worthwhile to investigate experimentally, the feasibility of such an operation. At that time, although fairly familiar with the general literature of intestinal surgery, the writer had seen no reference to such work having been done. The plan of operation adopted was extremely simple. A segment of ileum was isolated by dividing it at each end, being careful to preserve its vascular supply intact. The continuity of the ileum was restored by an end-to-end anastomosis of the bowel above and below the isolated loop. The colon was then divided. The segment of ileum was interposed between the divided ends of colon by two end-to-end anastomoses, care being taken that proximal end of colon was united to proximal end of ileum, and distal to distal ends likewise, so that the intercalated small bowel was arranged iso-peristaltically with the colon. Gaps in the mesentery were sutured as well as possible. (Fig. 1.)

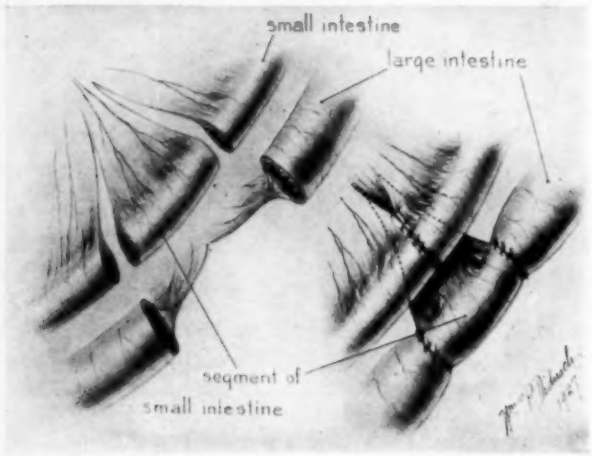

FIG. 1.—Interposition small bowel between ends of divided colon.

This experiment has been performed on some nineteen dogs, always under ether anæsthesia. The results have been interesting to study. The first two dogs died promptly, one being an anæsthesia accident, the other with extensive peritonitis. As the experiment involved three end-to-end anastomoses and the technic had not been well worked out, these fatalities were not particularly surprising. However, the first seven dogs proceeded to die in uniform succession, none surviving the fourth day. At autopsy several of these animals were found to have imperfect anastomosis, with small leaks and a limited peritonitis—not enough seemingly, to account for such prompt death. The others showed no gross lesion—no peritonitis, no obstruction, no hemorrhage. The transplanted loops were sometimes a little blue and

dusky. The dogs had bowel movements after the operation and they vomited very little.

At this period in the work, the idea was entertained that there must be some physiological incompatibility in the experiment, that prevented its successful accomplishment, and speculation began to arise as to the possible explanation. At the same time, it was appreciated that the experiment was a long one, rather difficult to keep on a plane of technical perfection, that some of the dogs were not in the best condition, and that several different operators were working—all of which might account for the failures. Also it was clearly understood that these were only negative results, and that the survival of one dog would offset all of them, and prove that the operation was possible of success. With the eighth dog, this positive success was attained. The dog was still living after three and a half weeks, and his nutrition and alimentary function were apparently normal. Meanwhile, other experiments have been carried out, and of a total of nineteen dogs, six lived long enough to say definitely that they survived the operation.

In surveying our experiments, we have noted two changes in the detail of operation that crept in almost imperceptibly. The transplanted segment of ileum in the first eight or nine cases was only about five to seven cm. long and its mesentery contained only one principle vein and artery. In the later cases the loops were gradually made longer up to twelve to fifteen cm., and the mesentery was selected to contain at least two sets of vessels. We think these longer loops are better as the anastomoses are not so close together, and there is better circulation. This may account, in part, for the more successful later experiments.

Autopsy on the first successful operation, the dog while still entirely well being sacrificed on the twenty-third day, showed the following: The peritoneum was entirely clean and all three anastomoses were well healed. The ileal anastomosis was adherent near the upper colon anastomosis. The implanted loop was functioning well as shown by the fact that the colon below it was full of fecal contents. The colon above also contained fæces, but the implanted segment itself was empty. Evidently the ileal loop maintained a different peristaltic function from the colon, as it did not retain fecal contents. The colon above the implanted loop was stimulated mechanically while the dog was still alive under ether. A contraction wave passed down to the anastomosis, then stopped, and the implanted loop went into a general contraction, shortening and thickening, but not showing a definite wave. Colon beyond ileal segment then developed a wave contraction. Contents from above segment could easily be milked through it.

After the work just described had been in progress some time, it was learned that in this instance, as has happened so many times before, others had done already, what was believed to be a new thing. The Italian Vignolo † reported in 1912, having done almost the same experiment on animals, for the same reasons that led the present writer to undertake his investigation, and furthermore, announced the successful performance of a very similar operation on a human patient. This man had undergone an extensive resection of the pelvic colon for carcinoma, leaving him in the same con-

† Vignolo, Q.: Archives génerales de chirurgie, Paris, 1912, vol. vi, p. 621.

dition as the patient described in this paper, namely, with a high sigmoid terminal colostomy and a closed blind pouch of rectum below. This had been done April 19, 1910. On August 1, 1910, Vignolo performed what he called an ileo-colo-rectoplasty. He isolated a loop of ileum, about forty cm., above the ileo-cæcal valve, where the mesentery is widest, and reëstablished the ileum above and below this segment by end-to-end suture. Then the upper end of the isolated segment was united to the descending colon by a lateral anastomosis, the terminal colostomy not being disturbed at that time. The distal end of the segment of ileum was passed down into the remaining rectal pouch. From below the mucosa of this rectal pouch was dissected off, and the stump of ileal segment sutured to the anal skin. Recovery from operation was followed by the evacuation of part of the fecal contents through the reconstituted anus and part through colostomy. On fortieth day it was contemplated to close colostomy, but it was then discovered that there were palpable metastases in lower, and further operative work was abandoned.

It will be seen that, except for minor details, Vignolo has anticipated completely the idea and work herewith presented. In his paper he describes his procedure as original, and it is probable that he is the first who has performed such an operation. Furthermore, he has apparently had few, if any, followers. In the volume on Cancer of the Rectum, by Chalier and Mondor,‡ published in 1924, the work of Vignolo is extensively referred to, but no subsequent reference is given in an extensive bibliography. Chalier and Mondor themselves advise the method of mobilization of the descending colon for uniting the sigmoid to the rectum. Soresi,¶ however, has reported similar experiments to those of Vignolo and the writer, and in a personal communication states that he has applied the method clinically.

In summarizing the matter, it may be said that occasionally the extirpation of large parts of the colon, particularly the recto-sigmoid, makes it difficult to unite the separated extremities and so preserve the function of the anus. In certain cases it would be most helpful if the defect thus created could be made good by the substitution of a segment of small bowel, interposed between the divided ends of the colon. The work herewith reported, and the previous work referred to, indicate that such a procedure is feasible, and should be considered when the surgeon is confronted with the problem of colon reconstruction.

The writer wishes to point out that he has not considered the question of how extensive the original attack on the colon should be, and does not wish to give the impression that the possibility of utilizing the rectal stump and preserving a functioning anus, should exert any influence toward preserving these structures when by so doing the completeness and success of the primary operation may be jeopardized.

‡ Chalier et Mondor: Cancer du Rectum, Paris, 1924, p. 358.

¶ Soresi, A. L.: Surg., Gyn. and Obstet., 1915, p. 668.

Protocols of Experiments

Dog No. 1.—Operation December 16, 1926. Died on third day after operation. Interposed sigmoid was blue and there were leaks at both anastomoses.

Dog. No. 2.—Operation December 21, 1926. Death immediately after operation from fault of the anæsthesia.

Dog No. 3.—Operation December 21, 1926. Died on fourth day, after increasing weakness, but without vomiting. Bowels moved. Autopsy showed no leaks, no obstruction, no peritonitis. Cause of death not clear.

Dog No. 4.—Operation January 7, 1927. Died on fourth day after increasing weakness. No vomiting. Bowels moved, stool normal. At autopsy no obstruction, no peritonitis. Anastomosis intact. Cause of death not clear.

Dog No. 5.—Operation January 14, 1926. Dog was sick from the beginning and died on the second day after operation. No vomiting. Bowels moved. Autopsy showed no obstruction, no peritonitis. Anastomoses were intact and patent.

Dog No. 6.—Operation January 21, 1927. Dog did fairly well for three days. Weaker on third day and died on the fourth. No vomiting, bowels moved. Autopsy showed slight leak at the upper colon anastomosis. Slight peritonitis. No obstruction. Peritonitis not regarded as sufficient to cause death.

Dog No. 7.—This dog on milk and bread diet for four days before operation, to get blood readings. Operation March 4, 1927. On the third day vomited a few times. Bowels had moved well. On the fourth day became weaker and died. Milk and bread diet was continued all along. Autopsy showed slight leak at the colon anastomosis. Very small amount of peritoneal fluid. Do not regard peritonitis as accountable for death. In this case, blood studies were as follows:

	N.P.N.	Total proteins	Cl.
Normal before operation	32	7.6	540
On post-operative day—2–24 hrs.	45	7.8	500
On post-operative day—3–48 hrs.	47	8.0	475

It will be noted that these figures indicate very much the same picture as that seen in intestinal obstruction.

Dog No. 8.—Operation April 12, 1927. Sacrificed on May 5. Dog had been perfectly well until that time. Autopsy showed no peritonitis, no obstruction. Anastomoses perfect and the segment of interposed bowel functioning.

Dog No. 9.—Operation April 16, died April 19. Small leak at ileal anastomosis with limited peritonitis. Loop of gut strangulated through opening in mesentery.

Dog No. 10.—Operation April 19, 1927. Still living and well. Bowels moving normally.

Dog. No. 11.—Died on fourth day with general peritonitis.

Dog No. 12.—Died on fourth day with general peritonitis.

Dog No. 13.—Operation April 25, 1927. Still living and well.

Dog No. 14.—Operation April 26, 1927. Died on fourth day. Had leaks at upper colon anastomoses with general peritonitis.

Dog No. 15.—Operation April 29. Still living and well.

Dog No. 16.—Operation May 3, 1927. Died on May 6. Autopsy showed secondary obstruction and perforation at one of the anastomoses.

Dog No. 17.—Operation April 20, 1927. Still living and well.

Dog No. 18.—Operation April 29, 1927. Still living and well.

Dog. No. 19.—Operation May 3, 1927. Still living and well.

I wish to acknowledge the great assistance given me in the execution of this experimental work by Drs. Edward James, F. C. Lee, Thomas R. Chambers, William Noble and Arthur H. Hebb.

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FISTULÆ OF THE SMALL AND LARGE INTESTINE*

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No segment of the alimentary canal between the duodenum and the anal orifice is immune to the development of fistulæ. This paper, however, is restricted to the consideration of fistulæ above the level of the rectum, in which location fistulæ which are very common, present an interesting chapter of surgery that has never perhaps received the attention it deserved.

Intestinal fistulæ may be conveniently divided into two large groups: (a) one, the more frequent, in which the fistula opens externally on some part of the abdominal wall, and (b) in which, in the absence of such an opening, the fistula connects the lumina of two or more hollow viscera. Theoretically a third variety is possible, in which the fistulous tract is a persistent channel through which the contents of a contiguous abscess have previously discharged into a hollow viscus. In this last-mentioned process nature has usually proved efficient not only in selecting an advantageous exit for the purulent material, but in promptly healing both the abscess cavity and the fistulous tract as well.

Fistulæ connecting two or more hollow viscera may either cause characteristic symptoms or their existence may be revealed only when the abdominal cavity is explored. The not infrequent fistulous formation between the stomach and large intestine from the extension of the ulceration of a gastro-enterostomy orifice, or less frequently from the extension of a destructive malignant process, is followed by the eructation and regurgitation of the colonic contents that have passed into the stomach, and usually by progressive emaciation, due to the passage of an insufficient quantity of stomach contents directly into the lower segment of the alimentary canal. On the other hand, nature's effort to relieve unusual biliary obstruction by the discharge of the contents of the gall-bladder directly through a fistulous communication into the contiguous duodenum affords at least temporary relief, while the presence of the fistulous tract, although it may be suspected, cannot be actually demonstrated until the radical cure of the cholelithiasis is undertaken.

Fistulæ that open externally usually present the unmistakable discharge of the contents of that segment of the intestine, in which their inner orifice is situated. The quantity of this discharge depends upon the length of the fistulous tract, the degree, if any, of its tortuosity, and the size of the inner orifice. In one instance observed by the writer, a fistula following an operation for an abscess connected with the appendix, was so small that only an occasional puff of gas escaped at intervals through an opening, into which only a slender probe could be inserted for a short distance. After five weeks

* Read before the New York Surgical Society, April 13, 1927.

this fistulous tract closed spontaneously. It is also quite possible for the discharge, either of gas alone, or of gas mixed with intestinal contents, to be intermittent, with periods of several weeks' duration in which the outer orifice presents the appearance of an ordinary sinus. In one instance of this type following an operation for the relief of a pelvic abscess, bismuth injected into the sinus prior to the discharge of either gas or intestinal contents, was found by an immediate X-ray to have passed into the intestine, from which it was subsequently discharged through the rectum. In this case the inner orifice was in the beginning valvular, and allowed the entrance of extraneous material under pressure but not, for a time at least, the exit of intestinal contents.

All of these fistulæ have a longer or shorter intervening tract between the hollow viscus and the skin. When this tract is absent and the visceral mucous membrane and the skin are continuous, the discharge of intestinal contents in a quantity which varies directly with the size of the orifice is inevitable.

The location and size of fistulæ of the duodenum and colon are ordinarily indicated by the character and quantity of the discharge. More precise information of the location of the inner orifice and the character of the fistulous canal can be obtained by an X-ray following a bismuth meal or a bismuth enema. In the small intestine, however, this method is obviously impracticable and the location of the inner orifice can be roughly estimated only by the length of time elapsing between the administration of an aniline dye in the food and its appearance in the discharge.

While intestinal fistulæ usually develop spontaneously in connection with some abdominal lesion, a much smaller number are intentionally established by the surgeon for the relief of intestinal obstruction, including the condition of intestinal paresis due to septic peritonitis. In other cases, as after the closure of an acute perforating gastric or duodenal ulcer, a jejunostomy is done by some surgeons to place the sutured area at rest and to provide for the introduction of fluids and nourishment. Fistulæ done under such circumstances frequently save life, and usually close spontaneously after they have served their purpose. Exceptionally they persist, and if the opening is in the upper part of the intestine and if it discharges the major portion of the intestinal contents, its closure, especially in the weakened condition of the patient, may be both serious and difficult.

A knowledge of the etiology of fistulæ that develop spontaneously frequently leads to their successful prophylaxis. They are likely to follow the impairment of the circulation of any part of the intestinal canal. Such a circulatory disturbance may develop in the duodenum in the course of the removal of a gall-bladder, especially when numerous and firm adhesions make anatomical identification difficult. In the early days of kidney surgery fistulæ of the duodenum occasionally followed a right lumbar nephrectomy or nephrotomy. In tubercular or malignant involvement of one or more of the abdominal contents the circulation of the affected intestine may be so curtailed as to favor fistulous formation. Thus after a laparotomy for a tuber-

cular peritonitis, or after the exploration of inoperable malignant growths, fistulæ occasionally develop in the abdominal incision notwithstanding the fact that it had been completely closed without drainage. In cases of the sudden complete exclusion of the circulation of an intestinal loop as in strangulated hernia, the formation of a fistula is nature's method of relieving the obstruction. The writer recalls such a case when an interne in the service of the late Doctor Bull at the New York Hospital, in which the entire contents of the small intestine were discharged through a fistulous opening. As conservative measures failed to check the discharge, and as no operation was undertaken for its relief, the patient gradually succumbed to a slow starvation. In the present state of efficient abdominal surgery, some radical measures would doubtless be attempted in a desperate condition of this character. Probably localized infection, resulting in abscess in close proximity to some intestinal loop, is the most frequent cause of fistulæ when the purulent material is not promptly evacuated by the surgeon. Thus localized abscesses resulting from slowly perforating ulcers on either side of the pyloric ring, the much more common abscesses due to an infected appendix, in which surgical relief is unduly delayed, and the long-standing abscesses from tubal infection in the pelvis predispose to fistulæ of the duodenum, the cæcum and lower ileum, and the sigmoid, respectively. In these cases of neglected suppuration, the post-operative development of one or more fistulæ may usually be foretold, and much trouble and anxiety may be averted by informing some responsible member of the patient's family of the possibility of the development of that complication.

It is quite obvious that careful dissection and separation of the gall-bladder and of the right kidney in operations on these organs, the delicate and gentle handling of the intestine in all laparotomies, the prompt relief of all strangulated herniæ, and the early evacuation of the pus in abdominal infection will effectively diminish the frequency of the development of intestinal fistulæ. Furthermore, in all abdominal conditions in which post-operative drainage is necessary, the greatest care should be exercised to prevent the contact of drainage material with any visceral line of suture. Furthermore, a drain should be selected which is free from rigidity in order that any unnecessary pressure upon the wall of some adjacent hollow viscus may be avoided. The daily change of the drain and its permanent removal at the earliest possible moment is greatly to be desired.

A variety of abdominal fistula in which the cause still remains unsolved and in which consequently no certain prophylactic measures have been devised is the gastro-colic fistula which occasionally follows the extension of a persistent or recurrent marginal ulceration of a gastro-enterostomy orifice. This fortunately infrequent complication occurs after gastro-enterostomies carried out in accordance with the most approved methods by surgeons of the greatest skill and experience. The persistent irritation of non-absorbable sutures in the approximation of the divided mucosæ is probably a predisposing cause and should be avoided. Recently an enthusiastic surgeon

in the Middle West, using a silk suture in this step of the operation, sought the approval of a much older and experienced colleague who dryly remarked, "That he had taken out a good many sutures, in patients in whom continued bleeding after operation indicated the persistence of ulceration," without unfortunately convincing the operator of the error of his way. It is scarcely necessary to add that the undue persistence of such marginal ulceration justifies operative revision of the site of the gastro-enterostomy before the colon becomes involved.

Apart from the observation of suitable prophylaxis, the treatment of fistula is either conservative or radical. Conservative measures are invariably indicated except in those fistulæ in the upper part of the alimentary canal, in which starvation is threatened by the discharge of a considerable portion of the intestinal contents. For example, in duodenal fistula, if the discharge of intestinal contents is so small (and this is not infrequently the case) that the patient receives adequate nourishment, operation is contra-indicated. If the discharge is, or becomes abundant, some measure must be promptly undertaken to check it while the condition of the patient still permits. On the other hand, the discharge of the entire intestinal contents through the fistulous orifice in the lower part of the small intestine or colon does not usually affect the general nutrition of the patient and radical treatment is justified only when, in spite of conservative measures continued for weeks or even months, the fistula persists.

The irritating effect of the discharge on the skin adjacent to the fistulous orifice is controlled, although not always successfully, by the application of suitable emollients and by the frequent change of the dressing, while an effort is made to minimize the discharge by the pressure of graduated tampons. Good results have followed the use of tampons impregnated with oil, especially in duodenal fistula in which the fistulous tract is narrow and tortuous.

Fecal fistulæ following the removal of an infected appendix are much less frequent if the stump of the ligated appendix is buried by a purse-string suture of absorbable material. This precaution is mentioned in view of the fact that only recently its omission was noticed in the operating room of one of the active hospitals of this city. When the gangrenous process involves the contiguous wall of the cæcum as well as the appendix, the friability of the necrotic tissue makes the infolding of the appendix stump much more difficult if not impossible and the subsequent development of a fecal fistula is almost inevitable. Notwithstanding the probability of the development of this complication, it is wiser not to attempt to avert it by the excision of the necrotic area with closure of the defect, but it is preferable by suture of the omentum to and over the suspicious area to endeavor to delay the formation of the threatened fistula until adhesions have shut off the general peritoneal cavity, a precaution which usually seems to diminish the size of the fistula and to shorten the period of its closure. Rarely in the opening of long-standing abscesses a necrotic segment of the intestinal wall may be evacuated with the pus, exposing a bridge of mucous membrane along the mesenteric

border between the upper and lower segments. If the condition of the patient permits, the affected small intestine should be excised with end-to-end anastomosis. In one such instance the post-operative drainage of the abscess cavity did not prevent primary union of the anastomosis. While a non-infected operative field is desirable, it is interesting to note that it is not essential to the proper conduct of intestinal repair.

The writer does not recall a fecal fistula following operation for an infected appendix that failed to close spontaneously provided that the appendix was removed and a purse-string suture applied to the ligated stump. In several cases in which the appendix was not removed, a small persistent fistula communicating with the cavity of the appendix was readily cured by the removal of the offending organ. It goes without saying that such experience extending over many years of active hospital practice is exceptional and that unquestionably some fistulæ of this group leading into the cæcum or lower ileum or both, which persist in spite of long-continued conservative treatment, can be permanently cured only by some form of operation.

Fistulæ connected with some part of the ascending, transverse, or descending colon are uncommon. On the other hand, the prevalence of pelvic abscess resulting from appendix or tubal infection, or to the threatened or actual perforation of a diverticulum, accounts for the relative frequency of fistulæ of the pelvic sigmoid. In the treatment of this variety conservatism is, if anything, more urgently indicated than in fistulæ of the cæcum for the prognosis of spontaneous closure is just as favorable and in the event of radical interference, the great depth of the fistulous orifice, the presence of baffling adhesions, and the frequent tortuosity of the fistulous tract make the operation both hazardous and difficult. It is particularly in this location that, as the fistulous orifice becomes narrowed, the retention of the discharge may lead to the development of one or more secondary abscesses of which drainage is necessary.

The condition of the patient in fistulæ of the duodenum or upper part of the small intestine in which the larger part of the intestinal contents are discharged through the fistulous orifice, does not ordinarily permit an operation of any magnitude or duration. For example, while a gastro-enterostomy, combined with a division and suture of the pylorus, might be expected to close such a fistula, the patient would probably succumb to the operation. Even in the less extensive operation required to expose and suture a fistula lower down in the small intestine, the ultimate outcome might easily be questionable. On this account some attempt should be made to reëstablish the normal passage of the intestinal current in all cases in which no distal cause of obstruction exists by the following procedure advocated by Koehler (*Zeit. fur Chirurgie,* 1925, vol. lxxiv, pp. 1886, 2655), which has the unquestioned merit of simplicity and of being capable of application without unduly taxing the patient's greatly lowered vitality. The measure referred to consists in the introduction of the horizontal portion of

a " T " tube of flexible rubber through the fistulous orifice into the lumen of the intestine, the longer and shorter segments lying, respectively, above and below the site of the fistulous orifice. The projecting vertical portion of the " T " passes through the opening. Peristaltic activity keeps the intra-intestinal tube in close contact with the intestinal wall and by thus closing the inner orifice of the fistula, permits the restoration of the normal current of intestinal contents. Various modifications of this measure may be utilized. Thus a rubber tube of which a gutter has been made seems to fulfil the indications of the horizontal portion of the " T." Another important modification consists in utilizing a " T " tube of which the horizontal portion is double, the additional segment being in close contact with the external abdominal wall. The vertical portion of the " T," connected with both horizontal segments, permits their approximation, the resulting pressure effectively closing the fistulous tract. The hollow vertical portion of the " T " tube, ordinarily closed by a clamp, serves for the introduction of fluids and nourishment at suitable intervals. When granulation has materially reduced the size of the fistulous orifice, the vertical and outer horizontal segments of the " T " tube can be easily severed, leaving the remaining horizontal segment within the intestine to be discharged through the rectum. This method is especially applicable in the treatment of intestinal fistulæ in which the affected loop can be readily approximated to the external abdominal wall, a type of fistula moreover, in which the discharge of intestinal contents is most likely to be excessive.

Radical treatment is indicated in intractable fistulæ in which conservative measures have failed. Either the simple extra-peritoneal suture of the orifice of the fistula may be attempted or the more formidable suture or resection. The former measure was much more frequently employed in pre-antiseptic days in view of its comparative freedom from risk. Because of its frequent failure to afford relief, it has been gradually superseded by the more radical intra-peritoneal attack of which the danger has been greatly diminished by improved surgical technic and skill. Detailed description of the radical treatment of fistulæ is unnecessary. Only the fact should be emphasized that, in resection of the affected loop, the continuity of the intestinal canal should be effected with the least possible sacrifice of normal intestine.

In conclusion the writer wishes to refer to the treatment of complete fistulæ of the lower part of the small intestine in which the distal segment of the intestine, retracted into the peritoneal cavity, lies at some distance from the anterior abdominal wall. Such extensive necrosis of an intestinal loop is a rare complication of an infected appendix. In one such instance observed by the writer, it had followed the mere incision of an abscess by a skilled and experienced colleague, the operation being restricted to that measure because of the desperate condition of the patient. The possibility of immediate repair in favorable cases of this character by end-to-end anastomosis has already been mentioned, a case being cited, in which a most satisfactory result was obtained.

The same treatment, indicated as a secondary measure when the primary operation has been limited to the drainage of the abscess cavity, is much facilitated by the temporary suture of both the proximal and distal intestinal orifices in the angles of the wound, if these openings can be readily recognized. As, however, intestinal necrosis is rarely apparent at the time of the primary operation and the fistula does not develop until several days afterward, the orifice of the distal loop is usually deeply seated and its identification, possible only after entering the peritoneal cavity, is very difficult owing to its collapsed condition and the presence of adhesions. When this condition exists the writer wishes to emphasize the following technic, of which the object is to facilitate the identification of the distal orifice with the least degree of intra-peritoneal manipulation and consequently with the least amount of soiling of the operative field.

The first step of the operation consists in the isolation of the proximal loop and its mesentery until the vertebral attachment of the latter structure is reached. After following this attachment a short distance downward and to the right, careful dissection is carried forward, keeping close to the mesenteric layer, until the orifice of the distal loop comes into view. Further adhesions between intestinal loops both above and below the exposed orifices can then be readily separated and an end-to-end anastomosis easily done.

Finally the comparative safety of the intra-peritoneal operation in a field necessarily contaminated by intestinal contents should be emphasized. While such a condition forbids the closure of the wound without drainage and may lead to infection of the abdominal wall, the repair of the sutured hollow viscera is usually complete or complicated only by slight temporary fistulous formation. The pre-antiseptic apprehension of the danger of this operation no longer obtains.

EPIGASTRIC HERNIA IN ITS RELATION TO INTRA-ABDOMINAL DISEASE*

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The problems involved in our diagnostic methods have always given the clinician, and the surgeon as well, great concern. The gastric crisis of syphilis has often been confused with perforating gastric ulcer, appendicitis with pneumonia and cholecystitis diagnosed where the thyroid gland was the offending organ. Patients, not infrequently, have made the rounds of the general practitioner, the gastro-enterologist, or even the surgeon, and a thorough hospital examination revealed a small epigastric hernia. Our incentive for this brief paper, first had its inception at the Mayo Clinic several months back. A patient was elsewhere told that he was suffering from a gastric ulcer. While his chief complaint was gastro-intestinal, yet a small epigastric hernia was responsible for the production of symptoms. We have had occasion since then to observe several very interesting cases of epigastric hernia. The recognition that the symptomatology as evidenced in epigastric hernia mimics gastro-intestinal disease will assuredly be conducive to a greater number of diagnoses of this condition.

CASE HISTORIES

Case I.—A male, age thirty-nine, white, presented himself with the complaint of intermittent pain referred to the epigastrium. There was nothing of import in the family or personal history. His symptoms were all referable to the gastro-intestinal tract. There was marked hunger. Pain was relieved by taking food but recurred a few hours later. A loss of weight of about twenty pounds in a year was noted. He first experienced pain a year ago, when he consulted a physician. He had had gastro-intestinal series and gall-bladder visualization. The diagnosis at that time was cholecystitis. The patient was a well-developed and nourished male. Head, ears and nose were negative. Eyes: pupils equal and regular, reacting normally to light and distance. No jaundice. Lungs and heart normal. Abdominal examination revealed sharp localized tenderness in region midway between umbilicus and xiphoid. There was marked spasm of the recti-muscles. No gall-bladder tenderness. While no hernia was detected in the patient when in recumbent position, yet on standing and asked to cough, a small mass was elicited in the midline about two inches above umbilicus. The patient was sent to the operating room and the hernia repaired. At the same time all intra-abdominal organs were examined, no pathology being found. An incidental appendectomy was done. Laboratory findings: Urine, negative; red blood-cells, 3,904,000; hæmoglobin, 80 per cent.; white blood-cells, 6200; 60 per cent. polyneutrophile. Wassermann and gastric

* Read before the New England Section of the American College of Surgeons, February 28, 1927.

analysis negative. Patient made an uneventful recovery and was discharged. There was no recurrence of symptoms.

Case II.—A female, age fifty-six, white, came under our observation with a train of symptoms pointing to gastro-intestinal involvement. She complained of a fulness after meals, belching and sourness. Distress worse at night, tending to ease toward morning. Could eat only certain foods, and avoided the so-called heavy foods. During the year she had lost about sixty pounds. She had been to several physicians, had undergone X-ray series, gastric analysis and stool examination. The diagnosis in her case was that of gastric ulcer or gastric carcinoma. She had been on a milk and cream régimen. General physical examination showed nothing of importance. She was an obese woman and careful palpation brought out a hernial mass in the midline above the umbilicus. The patient stated that she too noticed a bulging mass especially when on her feet for several hours. This patient was sent to the operating room and an abdominal exploratory as well as repair of the hernia was done. No pathology was found in the course of the visceral examination. Laboratory findings were essentially negative. Patient made an uneventful recovery, being discharged with no recurrence of symptoms.

Case III.—A female, age forty-five, white, presents herself complaining of a sharp pain in the epigastrium. This patient had undergone two abdominal operations for the relief of this pain, which a midline and McBurney scar corroborate. X-ray series, gastric analysis, blood Wassermann had been previously done. The pain complained of was constant, there being no relation to intake of food. Relief was forthcoming in the recumbent position. It is interesting to note that she had been on several dietary regimens. The clinical picture is that of a woman who has been in pain. The physical examination is essentially negative. The abdomen shows the telltale scars of previous operations, a per primam healed McBurney and midline incisions. The patient was examined in the upright posture. Marked tenderness was elicited at a point in the epigastrium midway between umbilicus and the xiphoid process. There were no bulging masses. In the midline corresponding to this point of tenderness, a small mass, size of a ten-cent piece was palpable which was exaggerated by coughing. The palpating finger encountered a crepitus sensation. There was increased pain as well. This pain and mass disappeared when patient was permitted to lie down. The diagnosis in this case was epigastric hernia and surgical intervention advised.

Etiology.—It is therefore not at all surprising that Ferrier in 1885, advanced the belief that many of the indefinite and vague histories of persistent pain and discomfort localized to the upper quadrant may find their underlying etiology in an undetected epigastric hernia. Epigastric hernia *per se* while not uncommon, yet finds its incidence about 2 per cent. as compared to other types of hernia. If we recall the anatomy of the region where epigastric hernia occurs, we find (*a*) That the recti-muscles are separated by a greater space above the umbilicus than below. (*b*) That the linea alba is merely a joining of the fibres of both anterior and posterior sheaths of the recti-muscles. (*c*) That the vessels of the falciform ligament perforate the transversalis fascia and linea alba.[1] One can readily see how a point of potential weakness is established at this perforation of vessels through the transversalis fascia. Increasing intra-abdominal pressure, after a tab of fat has found its way to this potential weak point, would bring on an enlargement, at the same time pushing the peritoneum ahead of it and the consequent hernial sac. When epigastric hernia does result it is found between the xiphoid and umbilicus. We must not overlook a congenital gap in the transversalis fascia as a causative factor. Quain[2] has divided epigastric hernia

into two types: (*a*) Peritoneal lipoma without a sac. (*b*) True hernia with a sac. We would, however, suggest that the type is dependent upon the duration of the condition. The first if let go long enough eventually goes into the second type.

Symptomatology.—The symptoms as are related by patients suffering from epigastric hernia unless one is acquainted with the condition are easily misleading. There is a history of antecedent painful indigestion, some in relation to meals, others have no association. The pain varies with the type of food ingested. Nausea, vomiting, belching of gas and sourness are complained of. Examination will elicit tenderness in the epigastrium and in the gall-bladder area. Referred pains to the shoulder blades and back have been offered. One might suggest that the pain and its relation to taking of food, and lack of periodicity would easily differentiate epigastric hernia from typical ulcer or gall-bladder or carcinoma histories. But if we consider that where organic lesions of the gastro-intestinal tract have been found, less than 50 per cent. of these cases give the so-called text-book picture. In a series of 100 cases examined at the Mayo Clinic where gastric ulcer was found at operation, 35 cases gave a so-called typical history, 31 a fair history, 29 a vague history, 4 mixed, 1 gall-bladder history. Our problem thus becomes real and is deserving of our best efforts.

Diagnosis.—Peculiarly enough it is the small hernia, the size of a pea, that gives the most trouble and symptoms simulating gastric ulcer, carcinoma, duodenal ulcer and gall-bladder. The large ones, on the other hand, are not so easily overlooked and lend themselves to an early diagnosis. Inspection and palpation of the linea alba with the patient in standing posture is of paramount importance. The palpable sensation suggesting "surgical crepitus" is encountered. Coughing or stooping over tends to bring the hernia to our attention. The history focussed toward the presence of a bulging mass should be stressed. Hæmatemesis, blood in the fæces, gastric dilatation usually point to an organic intestinal lesion. Epigastric hernia and gastric ulcer, as well as carcinoma and duodenal ulcer, have coexisted. Danon [3] reports several such cases. Gastric analysis offers us no solution. The X-ray examination in skilled hands is of great importance and organic lesions are easily determined. The referred pains which we encounter in this condition are somewhat clarified if we appreciate the underlying anatomy. The lower intercostal nerves perforate the opening in the linea alba and anastomose with the sympathetic nerves following the blood-vessels of the falciform ligament and in this way a relationship with the phrenic nerve is established. This would explain the vomiting and other gall-bladder symptoms. Further, there is an anastomosis set up with the splanchnic nerves which would account for the gastric syndrome occurring in epigastric hernia. The stimulus is derived from a pinching of these nerves at the small hernial opening. Some investigators have even advanced the theory that tugging or pulling on the omentum, as is often found in epigastric hernia, might be causal in the production of gastric ulcer. But Ivy [4] and Meyer, of Chicago, have sutured the omentum

to the sheath of the rectus muscle in 14 dogs, thus bringing about tugging of stomach by omentum. In no single case was there an ulcer found, though pouching of the pyloric portion of stomach was in evidence in six dogs. These findings strongly oppose the theory that epigastric hernia is a causative factor in the production of gastric ulcer.

Treatment.—Surgery is of course the treatment of choice. The operation performed is usually that as advocated by W. Mayo for umbilical hernia. Moschcowitz prefers the vertical incision and a suture placed above and below. Whichever method is employed, it is advisable to explore the intra-abdominal organs, particularly where gastro-intestinal involvement is suggested. Careful follow-up after these patients leave the hospital is essential.

CONCLUSIONS

1. Epigastric hernia may be overlooked unless we bear the condition in mind in its relation to upper intra-abdominal disease.

2. The small hernia gives the more striking symptoms.

3. Attention to gastro-intestinal series, Wassermann and other laboratory findings.

4. Surgery is indicated and an abdominal exploratory advisable in all suggested cases.

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NOTES ON THE COLLATERAL CIRCULATION IN BLOOD-VESSEL DISEASES OF THE LOWER EXTREMITIES

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One of the most remarkable phenomena in the human body is the manner in which the main arterial channels of a limb may become totally occluded without the part becoming gangrenous. It is a slow process, and a well-recognized one clinically, and when it occurs it is generally understood that the collateral circulation, so-called, has taken the place of the main arterial channels. In fact, the phenomenon is of such frequent occurrence—especially in the lower limbs—that we speak of the collateral circulation quite glibly; so much so, that one would think its channels were as well charted and as well known almost as are the main channels.

Fig. 1.—Case No. 2947.

Nothing of the sort is true. On the contrary, there is a decided ambiguity on the subject. An ambiguity that, more than likely, has arisen by reason of the fact that collateral blood channels are not stressed by the anatomists and the need for accurate knowledge on the subject has never seemed necessary to the operating surgeon since he has always felt that little or nothing could be done about it one way or the other. If he ligated a femoral artery, it has been his feeling that there might be a collateral circulation adequate to the needs of the situation or there might not, but that, other than ligating the accompanying vein to balance, in a way, the circulatory pressure in the limb and then wrapping the member

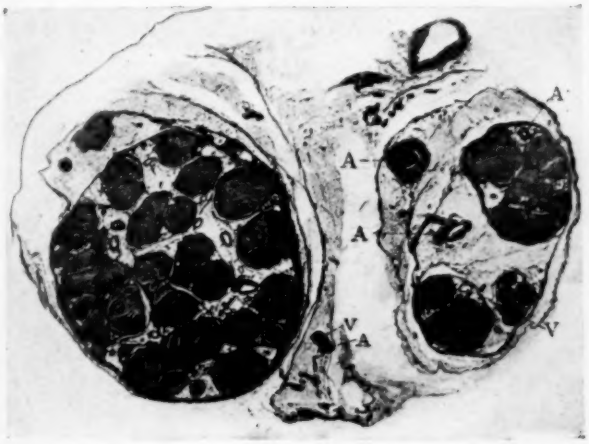

Fig. 2a.—Case No. 2852.

in cotton and keeping it warm generally and elevating it, there was nothing further for him to do; the matter was entirely out of his hands.

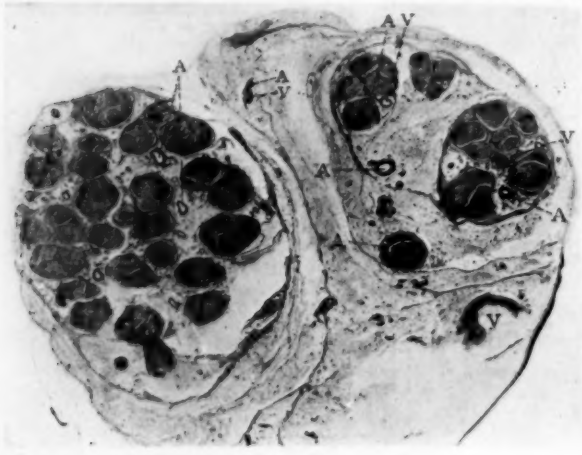

FIG. 2b.—Case No. 2852.

In a vague sort of way it has been felt that if the femoral artery were tied off below the profunda this latter vessel would be the main blood feeder to the leg. If the ligation were above the point at which this vessel comes off, then the gluteal arteries were to be in some way the source of supply. In any case, the whole thing was an indefinite sort of an affair and being in great part more a matter of chance than anything else, accurate knowledge in the premises was not needed and therefore was not sought.

Our own interest in the subject arose by reason of the studies we have been carrying on in regard to the threatened and real gangrenes that are produced by thrombotic and other processes. It is not so difficult to understand how the profunda artery can sustain a leg, but it is difficult to see how the gluteals can do it alone. Or at least it was difficult until we looked the matter up and found that they do it—or one might better say the inferior gluteal artery does it by way of the little arterial branches it gives off as it comes out of the pelvis *to the sciatic nerve.*

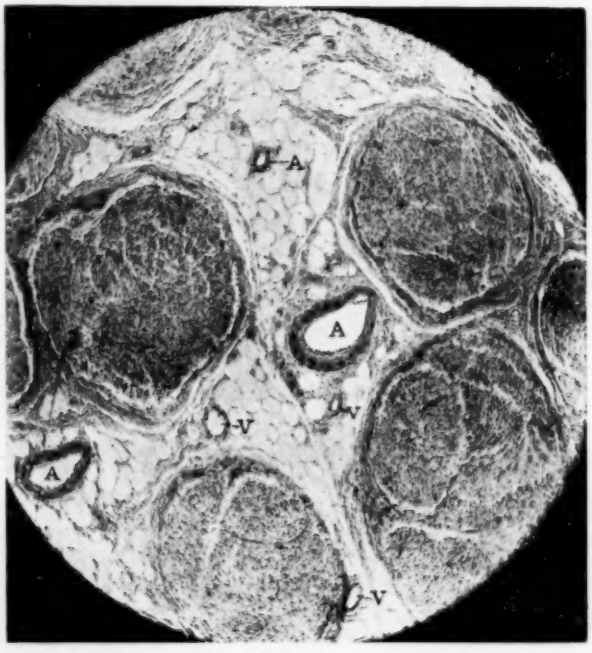

FIG. 2c.—Case No. 2852.

These arterial branches are normally quite small and insignificant, so small, that in amputating a limb for accidental injury—gunshot, etc., the sciatic

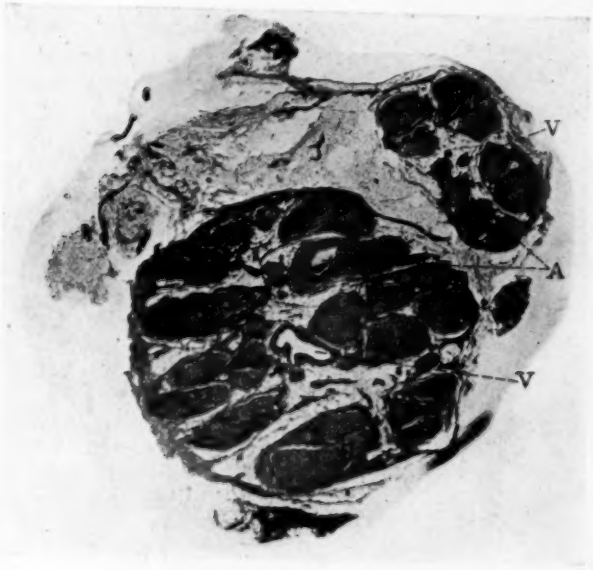

FIG. 3a.—Case No. 3225.

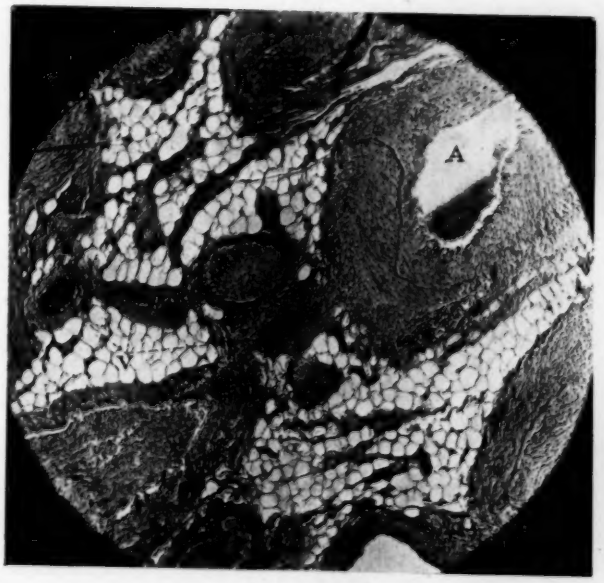

FIG. 3b.—No. 3225.

vessels are of such relative unimportance that one hardly has to ligate them. In the thigh amputations that are done for gangrene consequent upon profound arterial disease, however, the sciatic arteries are uniformly found to be increased in number and in calibre. They are about the only pulsating vessels found and require very careful ligation. Having their origin higher up than the thrombotic process usually rises in the arterial tree, they offer a direct line of blood flow to the tissues of the lower leg and foot. At times we have even thought their pulsation could be felt. In any case, their presence, their increase in size and calibre explains without any ambiguity the survival of a limb whose every normal channel may be completely occluded.*

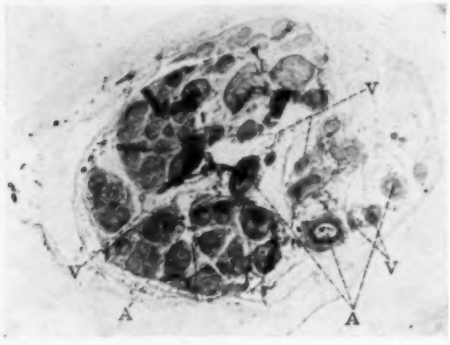

FIG. 4a.—Case No. 2917.

In order, however, to determine just how much of an increased vascularization takes place in and around the sciatic nerve of the gangrenes and the manner in which it is accomplished, we secured several autopsy specimens from normal limbs for comparison. All specimens, whether of the normal or of the pathological, were taken just below the mid-thigh, the reason for this being that this is the usual site of election in amputations done for vascular disease. At this point the sciatic nerve trunk is usually divided into a larger and smaller branch, the two branches being separated by loose connective tissue. The trunks in turn are divided by firmer connective tissue into funiculi. There is usually a moderate-sized vessel in each trunk, proportionate to its size. There may be a variation in that the blood-vessels may be present in the connective tissue between the trunks. It is interesting to note that vessels are not visible within the nerve tissue of the normal funiculus. This is in accordance with what histologists say, namely, that the endoneurium which consists of fibrous tissue between the nerve fibres, serves to conduct among them *relatively few capillary* blood-vessels which are supplied to the interior of each funiculus.

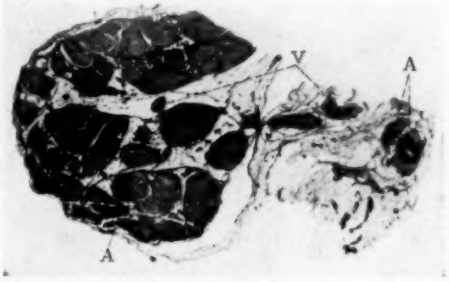

FIG. 4b.—Case No. 2917.

Figure 1 shows such a picture, No. 2947, age fifteen. This patient died of cerebral hemorrhage due to hæmophilia. The sciatic nerve has a blood supply that appears to be proportionate to the size of the nerve trunk and is quite the normal thing. It consists of a moderate-sized vessel and several veins. This vessel happens to be in the connective

* Bernheim, Bertram M.: The Significance of the Blood-pressure in Circulatory Disorders of the Extremities.

tissue between the trunks. A small vessel can be seen in an interfunicular septum. No vessels are made out within the funiculi themselves.

Figure 2-A, No. 16—No. 2852, age sixty-one—Sinai Hospital—History No. S 6085—diabetes mellitus—arteriosclerosis. This section was obtained at amputation for gangrene of the leg, therefore, according to the conception of collateral circulation advanced in this paper, the sciatic nerve should have shown, and does show, a marked increased vascularization as compared to the section shown above. Attention is called to the large and small arteries at "A" and the veins at "V."

FIG. 4c.—Case No. 2917.

Figure 2-B, taken 2 cm. lower than the above sections, shows this even more clearly.

Figure 2-C is a higher magnification of 2-B, giving a close up on the several vessels and funiculi. The vessels are numerous and the walls well developed. An occasional arteriole is seen within the funiculus.

Figure 3-A, No. 3225, male, age sixty-four—Sinai Hospital—History No. S 7599—arteriosclerosis. This section was obtained at amputation for gangrene. The nerve trunk is bifurcated, each branch having a large artery which is out of proportion to the size of the trunk. There are several smaller arteries present. The venous supply is also correspondingly large. There are several moderate-sized and small vessels present within the funiculi.

Figure 3-B is a higher magnification of 3-A, showing the arterial and venous walls and also smaller vessels.

Figure 4-A, No. 2917, male, age eighty-five—Sinai Hospital. History No. S 6538. Thrombo-angeitis obliterans. This section was obtained at amputation for gangrene. The nerve trunk is bifurcated. The greater bulk of the nerve tissue makes up the larger trunk, the smaller consisting of five small funiculi. The large trunk has an unusually large artery and several smaller ones. The smaller trunk has a tremendous artery and vein—also several smaller vessels.

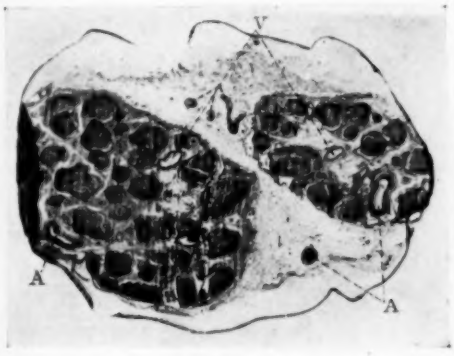

FIG. 5a.—Case No. 2944.

Figure 4-B, taken 2½ cm. lower than 4-A, shows further division of the sciatic nerve, and smaller amount of nerve tissue (one funiculus). The artery accompanying the latter, however, is comparatively tremendous and it is seen further from the main branch, apparently leaving the nerve trunk.

Figure 4-C is a higher magnification, showing the full development of the vessel

walls. This section shows the smaller vessels in the interfunicular septa, in the perifunicular connective tissue and within the funiculi.

Fig. 5, No. 2944, Sinai Hospital, J. F., male, age sixty-four. The nerve trunk is bifurcated. There is a large artery and vein in each trunk, which are out of proportion to the amount of nerve tissue. In addition, there are considerable-sized arteries and veins present between the trunks.

FIG. 5b.—Case No. 2944.

Figure 5-B is a higher magnification of the vessels in the lesser trunk, showing the development of the vessel walls.

Figure 6-A, No. 2759, Sinai Hospital, History No. S 6632—thrombo-angeitis obliterans, male, age forty-three. This section was obtained at amputation, just at the bifurcation of the sciatic nerve. There are two moderate-sized arteries and very many smaller-sized vessels. This section differs from the preceding ones, in that the increased vascularization is distributed in many smaller vessels rather than a few larger ones. It shows also very extensive increase in vascularization within the funiculi. There are numerous arterioles and venules present in the latter as shown in sections 6-B and 6-C.

Figure 7-A, J. R., History No. G. U. 348. This section was obtained at autopsy. Several months before the death of this patient, from embolism in the coronary artery, he recovered from a threatened gangrene following trauma to the big toe of the same limb from which this nerve trunk was later taken. At that time he had no pulsation below the femoral vessels. The fact that his recovery was complete, shows that his collateral circulation was well established and enough to carry on sufficient circulation. This section shows a huge artery and two accompanying veins, in addition to smaller well-developed vessels. The processes which caused occlusion of the popliteal and lower vessels is present in this large artery, *i.e.*, calcification of the walls and even bone formation. It is safe to say that this vessel played a great, if not the greatest part, in maintaining an adequate circulation for his limb.

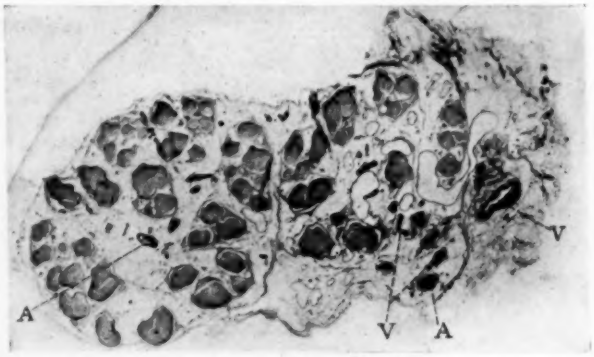

FIG. 6a.—Case No. 2759.

Figure 7-B is a higher magnification of a portion of section 7-A. Within the funiculi there are several well-developed arterioles and venules. Though this finding is

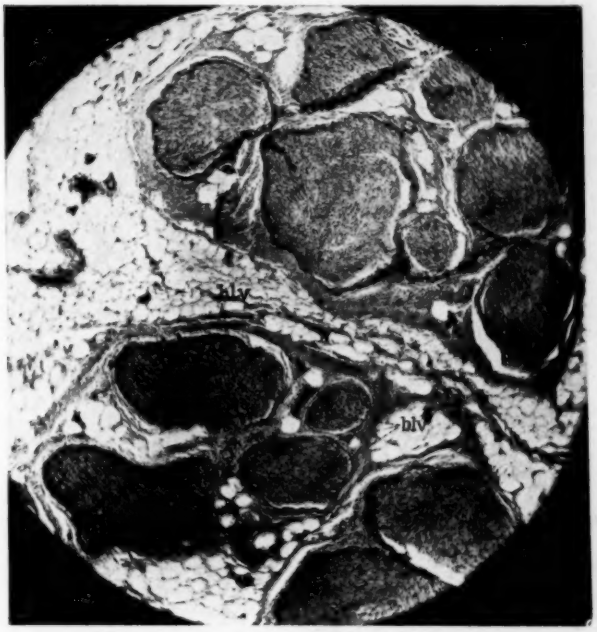

FIG. 6b.—Case No. 2759.

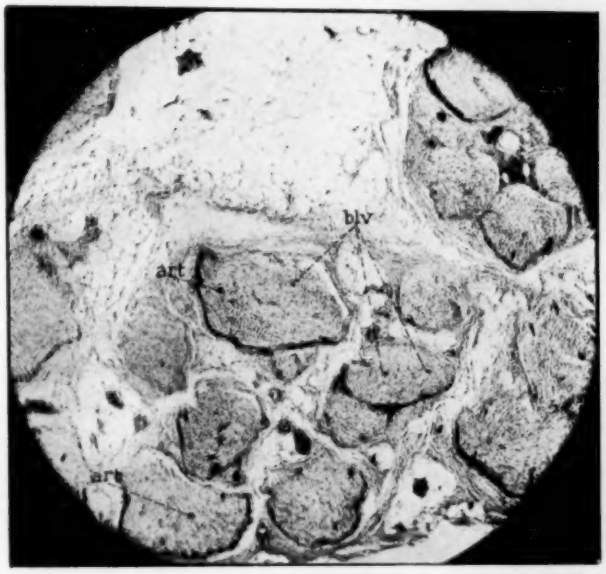

FIG. 6c.—Case No. 2759.

constant in all the preceding cases, they occur in greater profusion in this one. The greater number is undoubtedly indicative of more extensive development and efficiency of collateral circulation.

SUMMARY

(1) The normal sciatic nerve trunk has moderate-sized vessels, generally a proportionate-sized vessel for each division. There is an absence of blood-vessels, arterioles and venules within the nerve tissue of the funiculus. Only capillaries are present and these are not visible at ordinary magnification.

FIG. 7a.—Case No. 2928.

(2) In obstructive vascular disease of the limb, such as arteriosclerosis, thrombo-angeitis obliterans, etc., examination of the sciatic nerve reveals a definite increase in the number and size of the blood-vessels, both in perineural tissue and within the funiculi as well. These findings are constant.

(3) This increased vascularization accounts for the survival of certain limbs long after their main blood channels have become totally occluded.

(4) Knowledge of of this increased sciatic nerve vascularization is of importance in amputating gangrenous limbs.

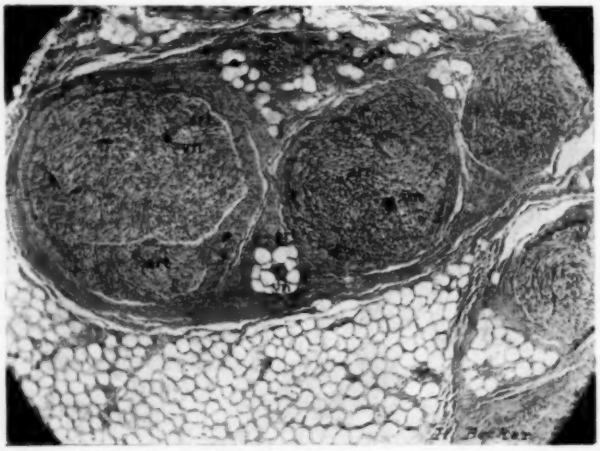

FIG. 7b.—Case No. 2928.

Finally attention is called to the rather startling fact that whatever the disease process that has affected (and obstructed) the main blood channels may be, the sciatic vessels are *not* similarly involved other than by a thickening of their walls and by some calcification as noted in section 7-A. Thrombosis of the sciatic vessels has not been noted in our experience.

LIGATION OF THE FEMORAL ARTERY BELOW THE ORIGIN OF THE PROFUNDA FEMORIS IN THE TREATMENT OF OBLITERATIVE ENDARTERITIS OF THE LEG

LEWIS AND REICHERT OPERATION

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Ligation of the femoral artery below the origin of the profunda femoris in the treatment of obliterative endarteritis (thrombo-angiitis obliterans) of the leg was first done by Dean Lewis, of the Johns Hopkins Hospital. The operation was described in an article by Doctor Lewis and Doctor Reichert in a recent issue of the Journal of the American Medical Association.[1]

The idea that this operation might be beneficial was suggested to Doctor Lewis by the statement in an article by Meleney and Miller [2] published in 1924, that they had been able to show an extensive collateral circulation in legs which had been amputated because of gangrene due to a vascular lesion similar in every way to obliterative endarteritis. Meleney and Miller injected the vessels of these amputated legs with bismuth oxychloride and then made röntgenograms of them. These röntgenograms showed in a striking way the constant establishment of an extensive collateral circulation, involving the smaller vessels especially. Doctor Lewis thereupon conceived the idea that the collateral circulation in the leg could be utilized and made to function more extensively in obliterative endarteritis.

Fig. 1.—Condition of foot at date of operation. Note destruction of tissue over joint of great toe. October 25, 1926.

The surgeon usually sees obliterative endarteritis late in the disease, when gangrene has already set in, and what he treats is really only a complication of a definite, generalized disease process. The atheromatous changes in the distal vessels develop slowly as a result of toxæmia from various types of chronic infection or as a result of prolonged irritation of the intima by abnormal products

of metabolism in excess in the circulation. The breaking down of the inner coat of the distal arterioles and infiltration with connective tissue gradually closes the lumen of the vessels, cuts off the blood supply and results in dry gangrene. When occlusion of the blood-vessels and interference with the blood supply sets in, Nature promptly begins to utilize the collateral circulation, and a race, as it were, is on between the occlusion of certain blood-vessels on the one hand and development of other blood-vessels

FIG. 2.—Note line of demarkation with normal granulation tissue. Tendon being covered. December 1, 1926.

FIG. 3.—Collateral circulation in the foot seen after injection of the popliteal artery in case of thrombo-angiitis obliterans.

in the collateral circulation on the other. Occlusion as a result of this disease progresses slowly, and the development of blood-vessels connected with the collateral circulation also takes place slowly. The result depends upon which process outstrips the other. Whether death of the part involved is to take place depends upon whether the rate of development of the condition causing an inadequate blood supply exceeds the rate of development of the collateral circulation, and this depends largely upon the potential capacity of the individual to develop a collateral circulation. Establishment of an equilibrium between the two processes means an adequate blood supply and life of the part; failure of the collateral circulation means an inadequate blood supply and death of the part, or gangrene.

Doctors Lewis and Reichert reasoned that ligation of the femoral artery below the origin of the profunda femoris would both inhibit the rate of occlusion of the diseased vessels on the one hand and stimulate the development of the collateral circulation on the other, and the results of his operation apparently justify these conclusions. The anatomy, physiology and pathology of the condition involved stamp the operation as a most rational procedure.

Amputation in the dark, without sufficient knowledge of where to amputate, was formerly the rule. Amputation in itself is easy to do, but to decide where to amputate in order to obtain the best result is not easy. Amputations above, below and through the knee have all been recommended, and each has been thought to be preferable to the other two. Modern surgeons prefer to amputate as low as possible, but ignorance of the location of the place in the blood-vessels where the circulation is obstructed is the chief obstacle and determination of this important point is difficult. Several years ago, Dr. Wm. R. McKinley, of Columbus, Miss.,[3] proposed that the diseased vessels be dissected upward until a point was reached where the blood supply appeared to be satisfactory and that amputation be done at this point. But the difficulties attending this procedure are almost too great to justify attempting it.

FIG. 4.—Collateral circulation in the leg and foot in case of thrombo-angiitis obliterans. Gangrene of toes occurred. A recent thrombus was found in the popliteal artery. This had to be removed before injection was made. It seems probable that the gangrene was coincident with the extent of the thrombus into the popliteal artery.

In treating these cases it should be the aim to save as much of the limb as possible. The blood supply must be maintained, and a definite line of demarcation must be established before amputation in order to obtain this object.

At first thought, ligation of the femoral artery seems to be quite a radical procedure, and many surgeons will hesitate before attempting it. But the profunda femoris is a large vessel, and, bearing in mind the extent to which collateral circulation can and will develop, the anastomotic possibilities of the profunda femoris as it passes down the back of the thigh and leg, are unusually great. This is well shown in the accompanying photograph of a röntgenogram of an injected leg. (Fig. 1.)

Ligation of the femoral artery below the origin of the profunda femoris in the case reported herewith caused no inconvenience and resulted in great improvement in the condition of the diseased leg in a remarkably short time. Healthy granulations developed in the affected area, the gangrene ceased to extend and was beginning to recede, and the foot was beginning to assume a healthier appearance, as may be seen in the accompanying photographs, but, unfortunately, thirty-six days after the operation the patient died suddenly as a result, apparently, of pulmonary embolism. Autopsy was refused.

CASE.—J. M., a white male, age fifty-nine, an American of Irish extraction, a messenger in the War Department, was admitted to Garfield Memorial Hospital, October 14, 1926, complaining of pain in the left foot, and of cough with expectoration of much thick, tenacious mucus. He had been subject to "colds" in the winter time, with dyspnœa and cough, and the expectoration of much thick muco-purulent material, and had been told that he had bronchial asthma. There was a tendency to constipation, but no other digestive disturbance. He had to rise at night about three times to urinate, but had no other genito-urinary symptoms, denied venereal disease, and otherwise had had no especial illness, no surgical operation or accident. He was abstemious, his habits were good, and his ordinary bodily functions were normal. There was no tendency to chronic illness in his family connection.

For the past three or four years he had had recurrent attacks of pain and cramps in the legs, below the knee. This pain was sharp and severe, came on suddenly and stopped suddenly. October 1, 1926, he noticed small water blisters on the left great toe. Next day the foot was so painful that he remained in bed, and he had been practically confined to bed ever since. A few days after the appearance of the blister, the toes became dusky in color, then purplish-blue, and the foot felt as if pins were sticking in it.

Examination showed him to be a rather poorly nourished, elderly, white male, with slight dyspnœa, sclerosis of the accessible vessel walls, slight opacity of both lenses, no teeth, slightly hypertrophied heart, the signs of a moderate degree of emphysema and chronic bronchitis, slight enlargement of the liver, varicose veins in both legs, marked hardening of the walls of the femorals and popliteal arteries, a faint pulsation in the posterior tibial arteries, absence of pulsation in the dorsalis pedis, and necrosis of the distal phalanges of the five toes on the left, especially marked in the left great toe. (Fig. 2.) There was no sensory disturbance, but on hanging the feet over the side of the bed the left foot became purplish-red and very painful. The blood-pressure was practically normal, the systolic pressure being 148, and the diastolic 80. An X-ray examination of the feet showed no abnormality of the bones. There was no anæmia or evidence of blood dyscrasia. The blood Wassermann reaction was negative. The fasting blood sugar was normal, 102 mgms. per 100 c.c. of blood. The urine contained a small quantity of albumin but was otherwise normal.

October 25, the left femoral artery was tied just proximal to Hunter's canal. There was no shock, and recovery from the operation was uneventful. From this time to December 1 the appearance of the foot indicated steady improvement in the circulation and subsidence of the gangrene. This is well shown in the accompanying photographs. No local treatment was employed for the first three weeks. Then the foot was soaked daily in hot water. The patient was allowed to be up in a chair and was beginning to get around, but the foot was still painful, so that he occasionally had to have codeine. December 1 he complained of a sense of fulness in the chest, and said that he had noticed this fulness for several days. His temperature was normal and there had been nothing else unusual in his condition. Half an hour later he became much worse, complained of severe pain in the chest, became dyspnœic and cyanotic, and suddenly expired.

It was impossible to secure permission for an autopsy, but the diseased foot was obtained. (Fig. 3.)

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CIRCULATORY FACTORS INFLUENCING NORMAL OSTEOGENESIS

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Recent investigations tend to show that malignant growth takes place in an almost anaërobic medium (Warburg [1]); or at least under the influence of a retarded circulation (Burrows [2]). Burrows, even postulates that all forms of biological growth depend on overcrowding of cells and a slowing of the blood flow.

The process of calcification of bone seemed to offer an excellent oppor-

Fig. 1.—Röntgenograms of rat, ventral surface down. The resected bone on the right side has been completely replaced with solid bony union, but on the left there is a wide space still present where no calcification is evident.

tunity to study the changes occurring under different artificially induced circulatory conditions. The amount of calcification could be followed from time to time by Röntgenograms, thus giving a graphic record of the growth changes.

Procedure.—Experiments were first undertaken on the albino rat. The fibula in this animal is solidly fused with the tibia above and below and bows outward in between the fixed points. It is thus possible to have the tibia maintain ideal splinting conditions for any experimental work such as simple fractures or resection of a portion of the fibula. Various methods of interfering with the venous circulation of the limb were attempted, such as application of a tourniquet, pressure, etc., but there were so many technical difficulties that a standard experiment as described below was adopted.

One-half centimetre of the mid-portion of the fibula was removed symmetrically on each leg under ether anæsthesia, aseptic technic being used. No attempt was made to preserve the periosteum. The right leg was then kept as

the control and the saphenous vein identified, ligated and divided in the left leg. Healing took place per primam in every instance. Röntgenograms were taken from time to time to follow the progress of healing. (Fig. 1.) The bone gradually filled in and united in the control leg in six weeks, but no union took place in the leg which had the venous system partially blocked, although the space between the bone ends lessened in amount. The result was uniform in a small series of rats

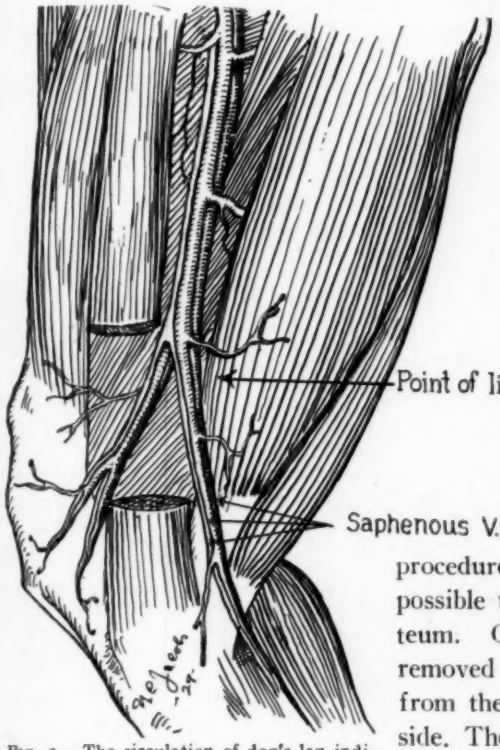


FIG. 2.—The circulation of dog's leg, indicating point of ligation in these experiments.

It was decided to transfer the same conditions of experiment to larger animals and accordingly dogs were selected and submitted to the same procedure. In this case, however, it was possible to reflect and preserve the periosteum. One-half centimetre of bone was removed at an equally measured distance from the upper end of the fibula on each side. The fibula in the dog is closely applied to the tibia in the lower half of the leg and then bows outward as a separate bone to reach the knee-joint level. The saphenous system enters in the lower third of the dog's leg and is accompanied by an artery.[3] The saphenous vein was ligated on the left leg and divided.

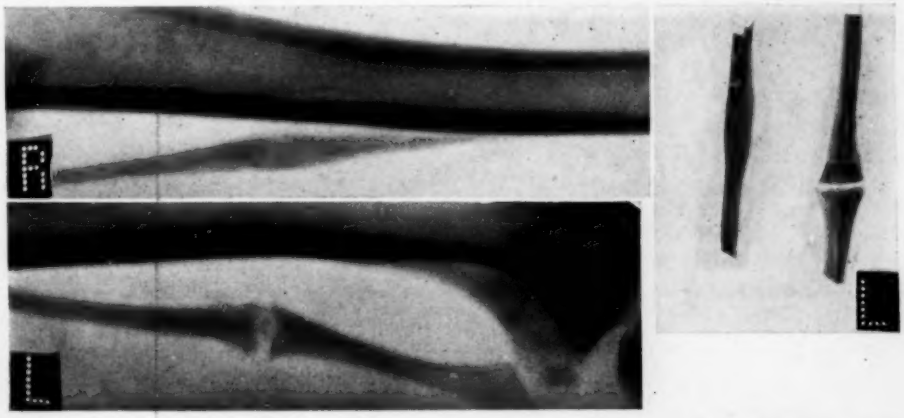


FIG. 3.—Dog No. 26=78, X-ray taken January 7, 1927. The right side shows almost complete union. The left side shows a gap still present. Bones removed February 2, 1927 and X-rayed, show complete union on right and non-union on left.

(Fig. 2.) Röntgenograms were again used as a check for the amount of callus formation. After nine weeks the control leg had healed solidly in every case, but the leg with the partially blocked venous system had failed to unite. (Fig. 3.) The result was uniform in a series of three dogs. The bone was

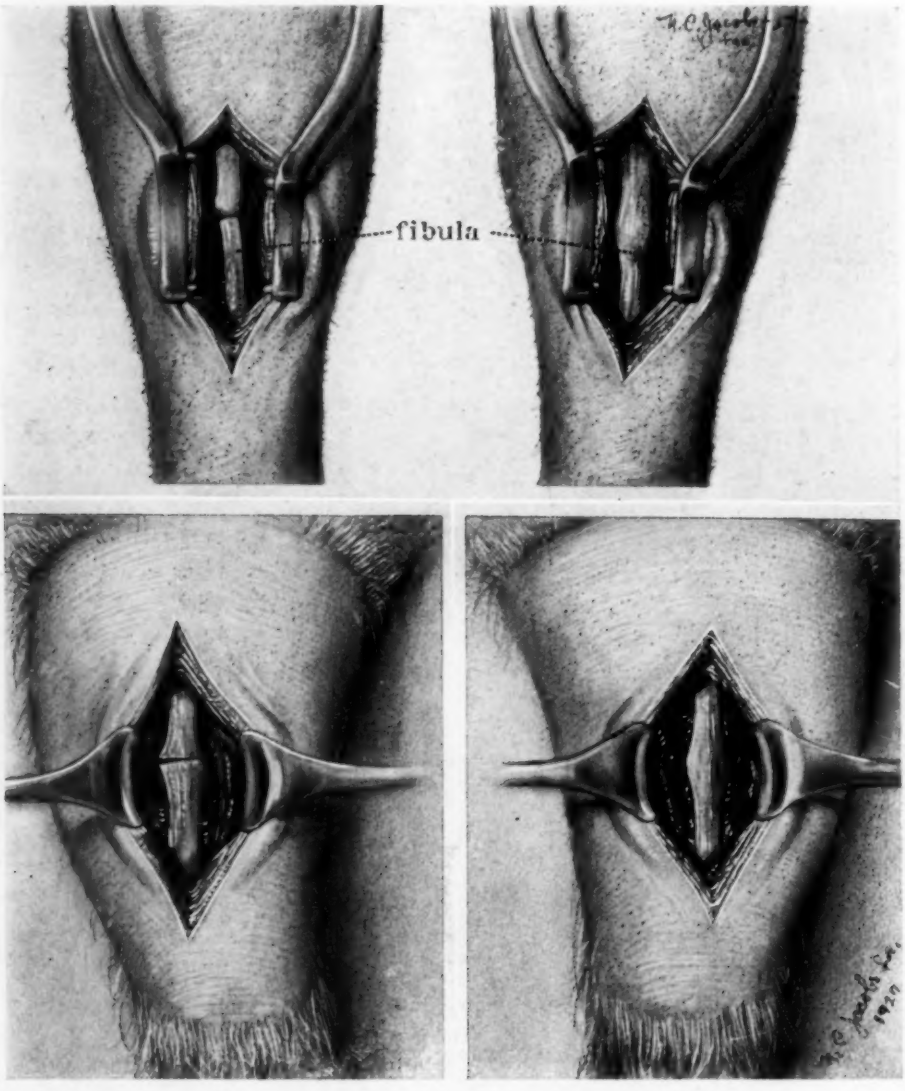


FIG. 4.—Condition of the resected bones in Dogs Nos. 26–70 and 26–78 as seen at exploratory operation. Complete union on the right and non-union on the left.

explored and specimens removed for study in two of these cases. Drawings show the gross comparison between the normal and the control sides. (Fig. 4.) Dog 26–70; 26–78.

Microscopic sections were also made and whereas the control leg shows osteogenesis taking place in a normal manner, the experimental side shows

very little calcium deposit, but consists mainly of cartilage and a small amount of osteoid tissue. There was nothing abnormal about this picture except that it had not advanced as far as on the control side. (Fig. 5.) Dog 26–78.

In a similar type experiment, simple fractures were made in two dogs

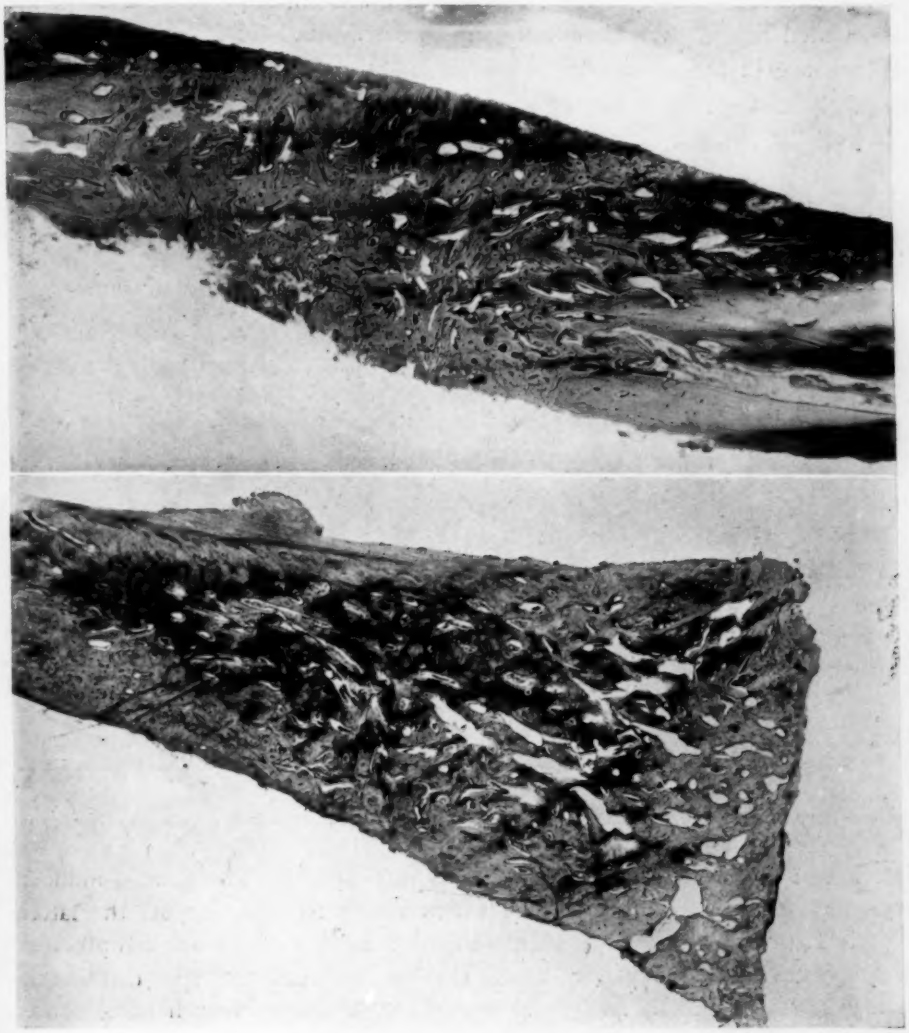
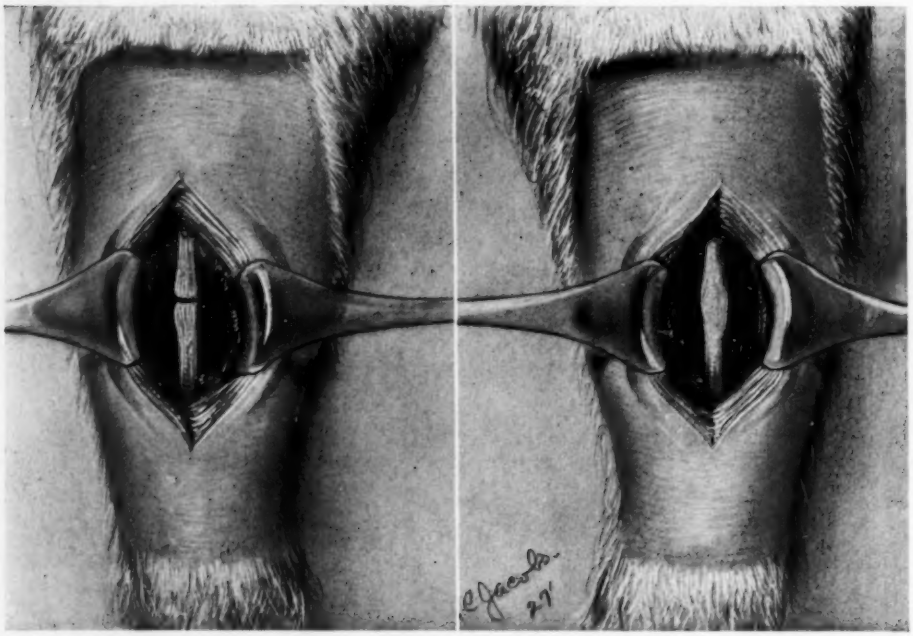


FIG. 5.—Dog No. 26–78. The upper microphotograph shows complete bony union between the bone ends. There is no cartilage or osteoid tissue present in the section, (x 15.) The lower microphotograph shows the end of one of the non-united bones. There is a narrow terminal zone of cartilage and osteoid tissue and patches of calcification throughout the section. The difference between this and the upper section is one of degree only. The bones were decalcified for cutting. (x 15.)

and no union took place on the experimented side, although the control side healed in seven weeks. One of these non-united fractures was explored and removed for study. A drawing shows the condition of the bones on removal. (Fig. 6.) Dog 26–90. *Discussion.*—Although the series is small, the result is so constant that it is assumed to be uniform under similar conditions.

Aside from a very slight amount of œdema which lasts for about one day on the experimented side, there is no outward sign of any disturbance. The temperature of the feet seems to be the same on palpation, although no delicate check has yet been made on this point. The outcome of the experimental ligation of part of the venous return was entirely different from the anticipated result. Whether the delay in osteogenesis is due primarily to a disturbance in the nutritional relations in thus altering the blood flow; or whether local changes in the chemical reaction are responsible, must be



LEFT POSTERIOR VIEW RIGHT

FIG. 6.—The bone as it appeared on exploratory operation following a simple fracture, complete healing on right and non-union on left.

determined by further work which is now in progress. There are a number of reports already in the literature which would tend to support the latter hypothesis.[4, 5, 6] These experiments might have a bearing on the problem of delayed or non-union of fractures. It is possible that tearing or thrombosis of a part of the venous flow from the injured member in such cases determines the velocity of the repair of the bone. It might be necessary also to take into consideration the influence of pressure from splints or casts on the venous circulation.

Summary.—When a resection or fracture of a portion of the fibula is made in the white rat or dog, union takes place after a certain period of time. If in addition to the above experiment under exactly the same conditions, the saphenous vein is divided, bony union is delayed beyond the normal repair period. Whether union ever takes place or when it takes place must be left for further observations.

Conclusions.—A partial block of the veins of a limb in which there is a fracture seems to cause delay in the union of the fracture. The same holds for a resection. As yet no explanation of this phenomenon is apparent.

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ANASTOMOSIS OF PORTAL VEIN WITH INFERIOR VENA CAVA*

A THOROUGHLY TESTED AND SATISFACTORY METHOD OF MAKING AN ECK FISTULA

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Review of the Literature.—It is just fifty years since N. V. Eck first described his method of anastomosing the portal vein with the inferior vena cava. This method has undergone numerous modifications, involving all of the methods employed in the anastomosis of tubular structures. The persistence of this difficult procedure has depended on its importance in the investigation of problems of the physiology of the liver. The true Eck fistula comprises not only the anastomosis of these two large veins, but the ligature of the portal vein close to the liver, and well above any of the portal collaterals. The so-called reverse Eck fistula implies the ligation of the vena cava above the anastomosis, so that the systemic circulation from the abdomen and lower extremities passes through the liver before entering the heart. This variation has found its use in complete removal of the liver, since, by shunting the systemic blood through the portal system, the collaterals around the liver are established by the increased pressure in the portal vascular system, and hence a new pathway is made to serve after the liver has been removed. A certain number of the more practical methods, which cover the general principles involved in all, will be reviewed here.

Eck placed two rows of sutures for the anastomosis, leaving the last suture untied until after he had cut the window between the rows in the walls of the veins. The size of the window was limited by the length of the points of his scissors. Stolnikov modified this procedure by soldering guide wires and needles to the points of his scissors, so that the blades might be placed without tearing the veins. Pawlow and Nencki employed this method, soldering silver wires to the tips of the scissor-blades but found that the instrument failed frequently at critical times because the needles came off the guide wires or the wires became detached from the scissors. Italian investigators found copper wires to be more satisfactory than silver. Interrupted silk sutures were employed.

This scissor method was further refined by Bernheim, Homans and Voegtlin in 1909, and by Bernheim and Voegtlin in 1912. They used two rows of continuous sutures, and filled the gap through which the scissors were inserted with a mattress suture which was not tied until after the connecting lumen was cut. They devised special scissors, with a bent shank and a guard to make the insertion easier and to keep the instrument in line while it was being placed for cutting.

Queriolo employed a rigid tube to connect the portal vein and inferior vena cava. This technic was improved by von Karltreu, but he obtained poor results at best, and experienced the same difficulties that had confronted Queriolo: distortion of the blood channels and traction on the pancreaticoduodenal vein.

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Tansini implanted the cut end of the portal vein into the vena cava, between clamps, making an end-to-side anastomosis. Perroncito used this method and found it satisfactory on the whole, but it caused too much distortion and traction on the vessels involved.

Sweet adopted a method which required a small wire cautery. The anterior layer of sutures was placed and the cautery wires guided into position on silk sutures. After the anterior row of the suture line had been placed the cautery was turned on and a lumen burned out, after which the wires were withdrawn. The chief objection to this method is the uncertainty of action of the cautery.

Mention should be made, in connection with the methods involving clamps, of the one brought forward by Jeger, who employed small metal clamps modelled after curved gastro-enterostomy clamps. The procedure, once these clamps were in place, was the same as in performing gastro-enterostomy. Horsley devised clamps of a similar nature which have been used in the lateral anastomosing of vessels.

Fischler and Schroeder were the first to offer the method which employed a cutting suture. After placing one row of interrupted sutures, they introduced a heavy silk suture through both veins; this was sawed out after the anterior suture line of the anastomosis had been placed. The procedure was modified by Mann, who employed continuous sutures of fine silk instead of the interrupted sutures. Mann also introduced the "S" incision which greatly simplified the technical difficulties by securing good exposure. Fischler adopted this incision in his last description of his technic.

Bird devised an ingenious method which depended on a hæmostatic stitch, which everted small pleats in both the vessels to be anastomosed. The tops of these pleats were trimmed off and the anterior suture line placed in position. The hæmostatic suture was then removed with the result that the window dropped down into position.

All of the scissor methods are open to serious objections: there is danger either of cutting out the suture lines or of cutting the wall of either of the veins. Moreover, the size of the lumen so cut was necessarily limited to the length of the blade of the scissors. The direct end-to-side anastomosing and the implanting of a tube produce too much distortion and traction to permit satisfactory circulation. All methods in which interrupted sutures are employed are slow, and the danger of hemorrhage is greater since more manipulation within the abdominal cavity is necessary than with continuous sutures. The principal objection to Sweet's method is its extreme slowness. Bird reported that several of his dogs died because the stoma was not open. In the method described here, the window may be made any size desired, up to 4 cm. in length. Speed is gained by the use of continuous sutures and the "S" incision which gives wide exposure to the field. There is no greater risk of hemorrhage than from any other method, and the inherent simplicity of the procedure reduces this to a minimum.

Technic.—Animals.—This operation may be performed on dogs of any size, but it has been found advantageous to select animals weighing from 15 to 18 kg., of either sex (females preferred). Short-haired dogs with flat, broad chests are usually chosen.

Instruments.—No special instruments are required besides those necessary for blood-vessel suturing. All instruments may be placed in one pan at the beginning of the operation. The blood-vessel suture material is sterilized in mineral oil by boiling it on an electric plate. All other materials are sterilized in the usual manner. These materials comprise the usual instruments for opening and closing the abdomen, including a ligature carrier, an abdominal retractor, and a blood-vessel suturing outfit. This outfit contains three mosquito forceps and one *Rankin* m. j. straight hæmostat without teeth which is used as a needle holder. The suture material consists of (1) No. 0 silk,

threaded double, 40 cm. long, on a No. 12 Phœnix needle (Harper's), which has been cut down in length to from 1.5 to 1.7 cm. and resharpened. Two of these sutures are required, one for the anterior row and one for the posterior, and (2) No. D, buttonhole twist for the cutting suture; it is used double and threaded on a "milliner's" No. 8 needle (Roberts parabola). This needle is about 4.4 cm. long. Its tip is bent into an arc for its terminal 1 cm.

Preparation.—The animal is fasted for twenty-four hours prior to operation, but water is never withdrawn. The abdomen is shaved well over to the right side. After the dog is anæsthetized (ether anæsthesia) the skin is cleansed with benzine, and two coatings of iodine (2 per cent. in ether). The animal is first anæsthetized in a large chamber and then placed on the table when an intratracheal tube is inserted. This tube is connected with a can of ether having an opening at its top, so that the animal breathes over the surface of the ether. This has been found to be a satisfactory method of anæsthetizing; it is simple and the animal requires little or no watching.

Incision.—The animal is draped in the routine manner, with towels and sheet; room is left to the right and downward. The incision is started at the xiphoid, carried downward in the median line for from 5 to 7 cm. and then diagonally to the right across the abdomen, just below and parallel to the right costal margin for about 10 cm.; then it is carried directly downward for from 12 to 15 cm., depending on the size of the dog. This gives excellent exposure. The muscles and fascia are cut through together, and bleeding points caught in clamps. The preperitoneal fat is divided high near the xiphoid, since this keeps it out of the field without further difficulty as soon as the abdominal retractor is slipped into position.

Operation.—Once the abdomen is opened, and the intestines are properly placed, the assistant gently holds the portal vein in place, as directed by the operator. It is essential that he does not allow slipping or movement, since this generally starts small hemorrhages from the hole of the suture which is then being placed. The assistant must not try to sponge. Frequently it has been found that all the necessary retraction can be done satisfactorily with one hand; this is preferred because it affords the operator more room to work in the abdominal cavity. The assistant places the tip of his gloved finger over any small points which may ooze as this is the quickest and surest way of stopping oozing. The traction is somewhat complicated, being dorsal and caudal; at the same time the tips of the fingers keep the portal vein close to the vena cava, removing all tension from the suture lines. The various stages in the operation are as follows:

1. The fat and connective tissue around the portal vein is freed by blunt dissection for from 5 to 6 cm. The vena cava is usually sufficiently free of fat to make any preparation of this vessel unnecessary. With the help of an aneurism needle, a ligature is placed beneath the portal vein, high and close to the liver, above the entrance of the pancreaticoduodenal vein. The ends of this ligature are clamped and laid outside the abdomen and not tied until the last step before closing the abdomen.

2. The cephalic stay stuture is placed; first a bite of about 1 mm. is taken in the portal vein, and then the suture eased through for about half its length. Then the suture is carried through a corresponding point in the vena cava; while the assistant pushes the two vessels together, the operator ties the ends, and having put a mosquito clamp on the tied ends, lays them outside the abdominal cavity. The assistant must not let up at this stage, or a small tear in the portal vein may result with some oozing of blood. Then the caudal stay suture is placed, about 4 or 5 cm. further caudally along the course of these two vessels. Again, it is placed through the portal vein first and then through the vena cava, and tied gently while the assistant keeps the two veins in close proximity. A mosquito clamp is attached to the short end and laid outside the wound toward the assistant.

3. The posterior layer of sutures is now placed, the long end of this caudal stay suture being used to sew with. In fact, this has been found to be the most satisfactory suture for both anterior and posterior rows. The suture is continuous, going first through the portal vein and then through the vena cava. They are both taken in one bite, and pulled through tightly after each suture. Slight tension on each suture prevents oozing from the last stitch hole. The sutures are placed about 2 mm. apart. When the cephalic or stay suture is reached, the sewing thread is tied to the shorter thread of the cephalic stay suture for locking. Then both the sewing suture and the stay suture are laid outside the abdomen toward the operator: this frees the field for the placing of the cutting suture. The needle is grasped so that the plane of the arc on the point of the needle is at right angles to the plane of the needle holder, since this is the only way in which it may be definitely known just where the point of the needle will pierce the vein. The portal vein is entered close beside the caudal stay suture, and the point of the needle directed cephalad until it is almost opposite the cephalic stay suture. The point of the needle rests against the portal wall, where it may be easily seen, and it is brought forth close by; all tension is taken off the point of exit by pulling the suture over the finger. If this is done, there will be no hemorrhage from this point. The cephalic stay suture and the sewing suture are laid over on the assistant's side of the field, so that they may be out of the way while the cutting suture is placed in the vena cava. Care must be taken to prevent the cutting suture from going around either of these two sutures. The cutting suture needle is grasped once more, as before, and this time the vena cava is entered beside the cephalic stay suture pointing caudad parallel to the line of suture. The point is brought out of the vena cava opposite its point of entrance in the portal vein. The cutting suture is tried gently to be sure that it slides easily.

4 and 5. The anterior row of sutures is laid, the corner being rounded with great care. The same thread is taken with which the posterior row was placed, and a bite is taken in the vena cava above the place where the cutting suture emerges and enters the vessels. This is followed with a corresponding one in the portal vein. Another suture is placed in the vena cava, this time in the line of the anastomosis, and just outside the line of the cutting suture; still another suture is placed in the corresponding position in the portal vein. One more suture is placed in the vena cava, and then gently, as the assistant makes slight pressure against the portal vein, these sutures are drawn up. The anterior row may now easily be laid.

In laying the anterior row of sutures, care must be taken to avoid catching the cutting suture. This should afford no difficulty since the cutting suture can be seen through the wall of the portal vein unless the wall is unusually thick, and it can be felt through the vena cava if it is raised on the needle as it pierces the vessel. However, with moderate care, there is no danger of its being caught. To be sure, the operator may slide the cutting suture freely back and forth after every two or three sutures, to assure himself that the cutting suture is quite free. All that is necessary is to keep outside the line of the cutting suture and to keep a slight tension on the sewing thread so that the walls of the veins are lifted in a slight peak before the next bite is placed. Should the cutting suture become caught the sutures are removed after the needle has been cut off, back of the point where the lock has occurred. One sewing suture is tied here, and another is started at this point. The oozing from the holes made can be controlled in a few seconds by pressure from the tip of the finger. The anterior row of sutures is continued to the point opposite the emergence of the cutting suture. Both ends of the cutting suture are laid anteriorly, and a final bite is taken in the portal vein, and another in the vena cava, both a little larger than usual but the suture is not drawn tight. The end of the sewing suture is placed out of the wound on the side of the operator.

6. To remove the cutting suture, each end is firmly taken between the thumb and forefinger of each hand, and sawed with long, gentle, even strokes. The cutting suture

should slide easily. If there is any oozing as it passes a weak point in the suture line, it can be stopped by the gloved finger tip. When the suture has been sawed almost out of the lumen of the vessels the procedure is slowed since too much vigor at this stage

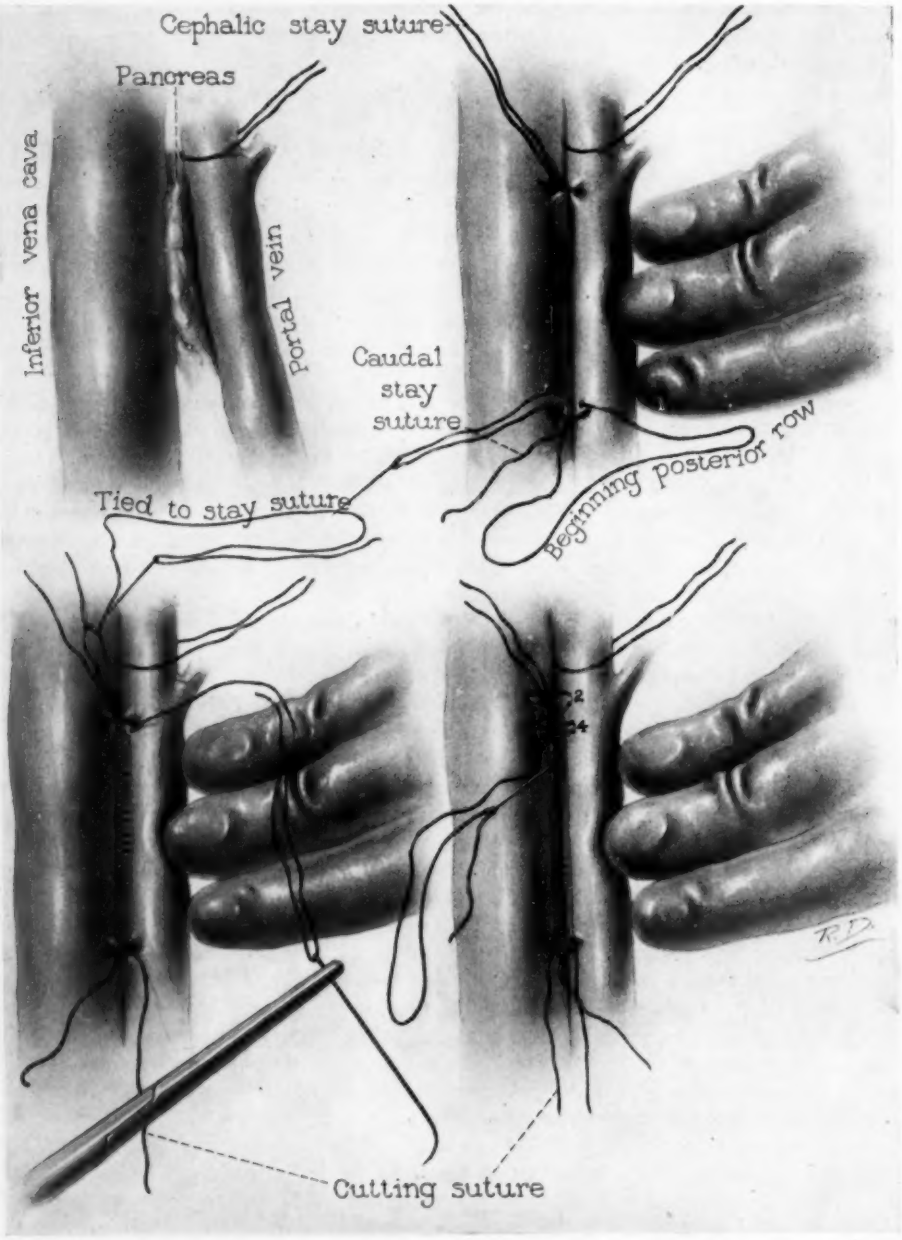

FIG. 1.—Carrying out, of the Eck fistula, stages 1 to 4

may cause a tear in the portal vein, and if the last stitch has caught the cutting suture, this may simply be pulled out without diminishing the extent of the anastomosis.

7. As the cutting suture is pulled out (stage 8 illustrates the manner in which cutting suture makes window) the two ends of the sewing suture are tied (one represents

the caudal stay suture, and the other the one with which the anterior suture line has been placed). The suture line of anastomosis is examined for bleeding, and if necessary an individual suture may be placed. Clots may be removed from the abdominal cavity. The assistant moves his right hand and retracts the liver upward so that the operator may tie the ligature placed about the portal vein at the beginning of the operation. The

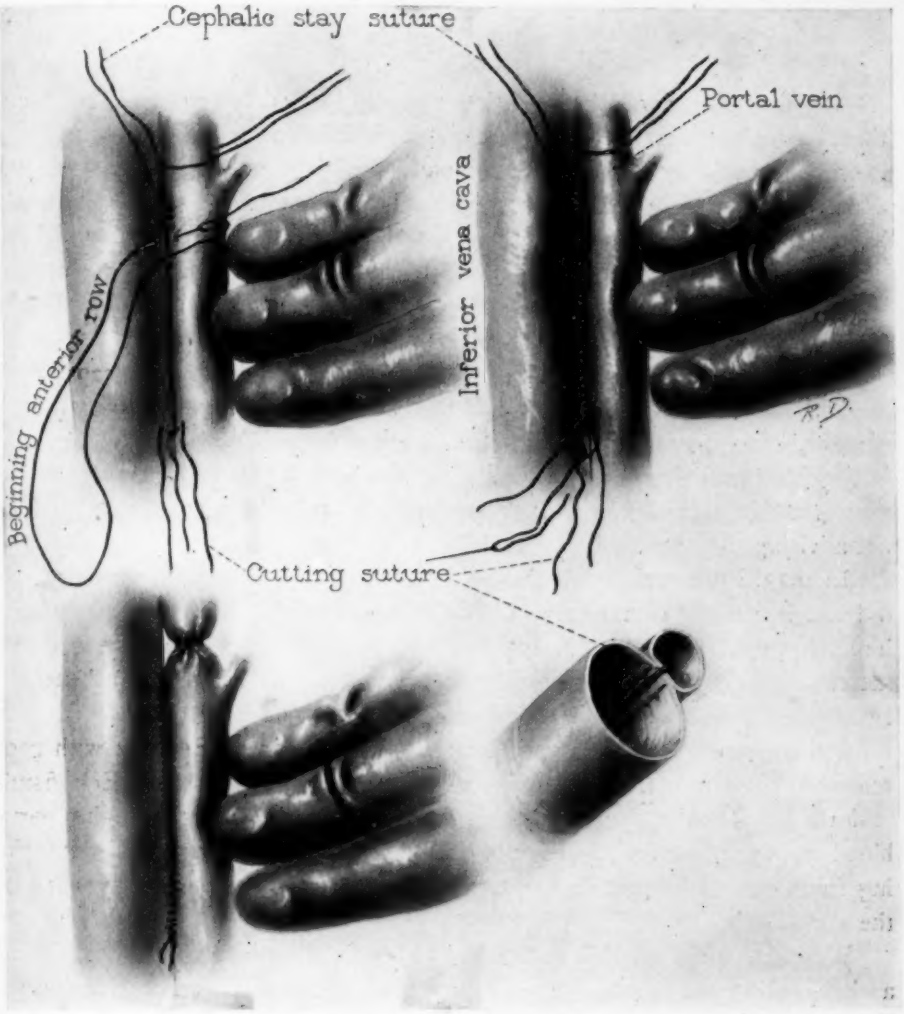

FIG. 2.—Carrying out of the Eck fistula, stages 5 to 8

ends of this ligature and of both stay sutures are now cut, and the operation is completed. (Figs. 1 and 2.)

Closure.—With a continuous suture of linen on a round, pointed, curved needle, the peritoneum and musculature are closed. Then two layers of continuous No. 2, iodized catgut on a cutting needle are placed, one through the fascia and the other through the subcutaneous fat. The skin is finally closed with linen on a spear-pointed needle. The only dressing is a single layer of gauze, which is painted with collodion, after the application of a single coating of iodine. In about a week the skin suture is cut and the wound is practically healed. Occasionally an abscess forms in the peritoneal suture

line. The suture can be removed without difficulty and the wound laid open around the abscess. The infected area is painted with iodine and dusted with drying powder.

Diet.—The dogs are given water immediately after operation. During the following day they are given the usual diet with the exception of meat. If they appear to be losing weight they are put on a high carbohydrate diet, consisting of half corn syrup and half milk, in sufficient quantity to increase the weight.

DISCUSSION

The operation for Eck fistula has been performed but rarely in man, and then only with a small degree of success. Vidal reported his first successful operation, performed in 1903 on a patient with cirrhosis of the liver and ascites. The patient lived four months, but the ascites recurred six weeks before death; death was due to an acute generalized infection, which he thought was of enterogenous origin. Vidal would not repeat the operation because it removed the liver as a filter from the portal circulation and side-tracked the hordes of microbes with undiminished virulence from the intestine directly into the systemic circulation and consequently death from septicæmia might be anticipated. He also believed that by shunting the liver in this manner, enough of its necessary functions were withdrawn to place almost impossible restrictions on the diet. The description of this case is quoted in most standard text-books of surgery and the authors agree with Vidal in not advising the operation.

In 1913, Rosenstein made the fistula successfully three times in man. He did not ligate the portal vein above the anastomosis. Simultaneously with him, Borgoraz transplanted, between clamps, the cut end of the superior mesenteric vein into the inferior vena cava; this was followed by beneficial results in a case of cirrhosis with ascites.

Quite recently Krestovsky duplicated the operation of Bogoraz with good results. He chose this type of operation instead of the true Eck fistula because he felt that by doing this he was leaving enough of the portal blood supply intact for the liver to maintain its deaminization and detoxifying functions. He suggested that the wiser course would be to omit ligating the portal vein.

Whether or not an Eck fistula would benefit a patient with cirrhosis and ascites is still open to question. If the ascites is due to portal obstruction the Eck fistula should relieve it. If an Eck fistula were made early the ascites might conceivably be prevented, but as the cirrhotic process goes on, evidently other factors than merely portal obstruction enter the picture. Simply raising the resistance within the portal circulation is possibly not the sole cause of ascites.

Neither an Eck fistula nor any of the other procedures devised to remove the cause of the ascites, remedy the underlying cirrhosis, which is in turn responsible for the ascites. The operation carries far too great a risk to make the likely benefits worth while, except possibly in special instances.

Many physiologic studies have been carried out on the Eck fistula animal with regard to the functions of the liver, but the conclusions arrived at in this manner have frequently been overestimated. The results are manifold and contradictory and confusing. Many of the animals do poorly and die from no particular cause. It is considered that the feeding of meat causes a particular type of intoxication resulting in death, and yet the manner in which poisoning occurs or why the animal dies is not known.

Certain investigators assert that Eck-fistula dogs can tolerate meat, others that they can if they have ground bone meal with it, while still others hold that not only meat, but meat extractives must be excluded from the animal's diet. However, in my experience dogs have been known to die in an intoxicated condition characteristically associated with meat poisoning, when no meat was given.

The technic described here should serve whenever a means of lateral anastomosis of veins is desirable. It is simple and rapid and requires no special instruments, only those used for ordinary blood-vessel surgery. It is offered as a thoroughly tested and exceedingly satisfactory method for making an Eck fistula.

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THE TREATMENT OF POST-OPERATIVE SUPPURATIVE PAROTIDITIS*

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In a previous article † the writer contended that post-operative suppurative parotiditis is of hæmatogenous origin. Added experiences and observations have confirmed this contention as logical. Cultures made of pus have demonstrated the staphylococcus to be the dominating infective organism in a large majority of cases.

In a later article ‡ the writer classified post-operative infective parotiditis into three types, citing illustrative cases of each: (1) Acute parotiditis or simple inflammation. (2) Acute suppurative parotiditis. (a) Circumscribed parotiditis or lobular parotiditis; (b) diffuse parotiditis. (3) Gangrenous parotiditis.

From this article the writer quotes the first four conclusions:

1. Every post-operative parotiditis is a potential lethal factor until it proves itself benign.

2. To await spontaneous evolution of parotiditis is jeopardizing life.

3. Differential diagnosis of these types suggests at once the method of relief, medical or surgical.

4. When surgical, operate early, with free incision, and open drainage.

The writer insists on active interference in this infection, both medical and if necessary, surgical. "Watchful waiting" is not to be associated. As illustrative, however, of the medical possibilities in such cases, I present the following instances, the surgical aspects of this disease having been previously considered in other articles:

Case I.—Mrs. M., age sixty-eight, suffering with general peritonitis from a perforated duodenal ulcer, was operated upon November 29, 1925. The ulcer was excised and closed; posterior gastro-enterostomy was performed with tube drainage in lower abdomen.

Temperature, 101; pulse, 124; hæmoglobins, 90 per cent.; reds, 4,400,000; whites, 7000; polymorphonuclears, 72 per cent.; lymphocytes, 24 per cent.; mononuclears, 4 per cent. Emaciated and septic; 1000 c.c. of 5 per cent. glucose solution were given intravenously and controlled with insulin.

On the third day a beginning parotiditis was noted. Four days later pus was massaged through Stenson's duct, culture of which demonstrated the staphylococcus. On the ninth day complete subsidence of parotid infection.

During the progress of the involvement, there were the associated symptoms of pain

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†Annals of Surgery, December, 1919.

‡Annals of Surgery, November, 1923.

and swelling, delirium and restlessness, dysphagia and involvement of the seventh nerve. The daily blood examination shows the progress of the infection, when on the third day the polymorphonuclears were 89 per cent., the lymphocytes 11 per cent., and whites 23,000. Special attention is called to the temperature and pulse record; the highest temperature recorded was 101.2, the highest pulse rate 110. The course of the disease was marked mostly by a temperature of 99.6, pulse 92.

The treatment consisted in the repeated massage of the parotid, the use of mouth wash and gargle, chewing gum, and large amounts of water, per orem, intravenously hyperdermoclysis and enteroclysis. The local application of iodine to gland and the use of ice bag. Four hours following the inception of the infection 5 c.c. of mercurochrome was given intravenously. Following the third injection it was noted the advance of the disease was checked, and the succeeding two injections rapidly produced a subsidence except the effects of the seventh nerve involvement.

The blood picture, the temperature and pulse, are significant and synchronous with the rise and fall of the infective process.

Case II.—Mrs. M., age twenty-three, was operated at St. Vincent's Hospital, April 21, 1926, for acute appendicitis and chronic infective tonsillitis.

Bronchitis developed with temperature 101 and pulse 138. Five c.c. of uritone was administered intravenously and repeated the following day, with the result of a subsidence of symptoms.

Fifth day left parotiditis developed and progressed to a diffuse inflammation of gland. The clinical picture is almost identical with Case I.

On the third day the white count shows 13,650, the highest. The temperature 101 and pulse 110.

Six days later complete subsidence of symptoms, except a nodule still remaining in the parotid in the submandibular fossa. Five days later suppuration ensued in this lobule and did not extrude itself through Stenson's duct.

A recurrence of her infective symptoms developed with delirium, restlessness and severe pain in ear. Temperature 100, pulse 110, whites 14,100.

Five days later patient agreed to operative intervention. This circumscribed or lobular abscess was opened and drained. Culture of pus showed staphylococcus.

The treatment as outlined in Case I was immediately begun on the first appearance of inflammation. Six intravenous injections of 5 c.c. mercurochrome were given, over a period of seven days.

Case III.—Mrs. P., age forty, suffering with relaxation of pelvic outlet with retroversion of uterus, was operated upon November 4, 1926, at St. Vincent's Hospital. Extensive anterior and posterior colporrhaphy, perineorrhaphy, and Gilliam-Crossen ligament operation were performed.

On the second day a beginning right parotiditis was noted. Temperature 101, pulse 100, restless, drowsy, pain in neck and face, profuse expectoration. White count 19,650.

On the third day symptoms aggravated, temperature 102, pulse 100.

The fourth day decided improvement in all symptoms; highest temperature 100, pulse 100, whites 11,700.

Subsidence of the suppuration on the tenth day of the inception of the infection, spontaneous evolution through Stenson's duct having taken place.

Culture of pus shows staphylococcus as the offending organism. The same medical treatment was here adopted as in the other two cases.

In a period of five days, four intravenous injections of 5 c.c. of mercurochrome were given, the first, four hours after the inception of the disease. Improvement was noted after second injection.

Case IV.—Mr. A. K., age eighteen, was operated upon December 8, 1926, at St.

Vincent's Hospital for general suppurative peritonitis due to gangrenous perforated appendicitis.

On the fifth day a beginning left parotiditis was noted in the submandibular fossa. This became diffuse on following day with temperature 101, pulse 120, whites 12,300, and was accompanied by the usual symptoms of parotiditis.

The course of the disease continued for seven days, the temperature and pulse fluctuating from the highest 101 and 120 to normal.

The highest leucocytes were on the third day 16,300, after which a daily examination shows a decline to normal.

In this period of seven days, the patient received the usual routine treatment. Five intravenous injections of 5 c.c. mercurochrome were given, the third day of which produced marked amelioration of symptoms.

Culture of pus from Stenson's duct shows staphylococcus.

Comments.—The writer has been unfortunate in having had many cases of post-operative infection of the parotid gland in its various manifestations, which have led to the clinical formation of the foregoing classification.

From the onset and progress of the selected illustrative cases above reported, I feel assured, clinically, that these cases checked in the beginning and due entirely to the staphylococcus as the inciting organism, would have progressed to the second type of classification or acute suppurative parotiditis of the diffuse variety, with destruction of the entire gland, necessitating the radical operation, and the possibility of a fatal termination.

Diffuse parotiditis represents surgical pathology of grave importance. The type is rare, and few cases, if any, are met with in the life work of the individual surgeon. Collectively there are many case reports.

Differentiation of less severe types may be determined as the hours elapse, as to probable severity, by the increase of both objective and subjective signs.

At no stage of the inflammation is there a diminution in the severity of symptoms; suppuration occurs early, from thirty-six to forty-eight hours; immense swelling of face; dysphagia; meningeal disturbances and seventh nerve irritation, associated with repeated chills, rigors, and high temperature, rapid pulse, and increased leucocytosis.

Comparing this clinical syndrome with the foregoing case reports, it must be admitted that, up to the beginning of the second or third day of the infection, the signs and symptoms are similar and of equal importance.

The treatment advocated has produced a marked amelioration of symptoms after the third day, when lethal results are to be anticipated.

Mercurochrome has a powerful selective destructive action on the staphylococcus, and it was this therapeutic action that led the writer to employ its use at the first sign of parotid involvement.

The writer doubts its usefulness in antagonizing other infective organisms of the parotid, but advocates its use in all infections of the gland, where possibly the staphylococcus may be the exciting cause.

In debilitated and exsanguinated cases, small doses as above are indicated, but in grave cases massive doses may be employed.

Reaction was noted in the administration of 5 c.c. in the above cases; in some, a rise in temperature and diarrhœa with abdominal pain; in one, involuntary evacuation.

SUMMARY

(1) When parotid suppuration results from the staphylococcus, the intravenous administration of mercurochrome in conjunction with proper post-operative care, will abort a destructive diffuse parotiditis to a benign.

(2) Daily intravenous administration of which should check or hold in abeyance the progress of the infection after the second or third dose.

(3) Then if no improvement, the case assumes surgical aspects, and proper surgical procedures should be adopted immediately.

(4) The gangrenous types, although all reports show invariably a fatality, mercurochrome should be tried with early incision and drainage.

(5) The writer calls attention to the Y incision which he advocated in a previous article, and which meets all the indications of the gangrenous type of parotiditis; extending from the zygoma in a curvilinear manner, following the sterno-cleido-mastoid to the supra-clavicular notch. Its posterior limb extending from the mastoid and joining it below the angle of the jaw.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held April 4, 1927

The President, Dr. Charles F. Mitchell, in the Chair

FLAIL ARM FROM INFANTILE PARALYSIS

Dr. J. Torrance Rugh presented a man, twenty years of age, who at the age of one year had been left with a practically flail arm as the result of an attack of anterior polymyelitis. There was no power about the left shoulder-joint except in the pectoralis major; the head of the humerus could be moved in any position about the glenoid cavity; relaxation was very great; there was no life in any of the muscles from the shoulder to the elbow; below the elbow he had slight power in the flexors and in the extensors of the fingers and also in the extensor carpi radialis, but none in the ulnaris and in the carpal flexors. The hand was in a position of exaggerated radial deformity and was also pulled upward in extension. The arm hung limp at the side and if he wished to raise it, the assistance of the other hand was required.

On February 17, 1925, Doctor Rugh operated upon the shoulder-joint, doing an arthrodesis, removing the cartilage from the head of the humerus, from the surface of the glenoid and from the under surface of the acromion, and from the tip of the coracoid. The arm was placed in a position of sixty degrees of abduction and the head of the bone was held in contact with the acromion, glenoid and coracoid by a kangaroo tendon suture passed through the head and tied over the top of the acromion. An aviation splint was applied to hold the arm in place. Infection of the wound occurred and was quite acute for a few days, but in two weeks it was completely healed and union between the humerus and the scapula took place. After four months' time, the brace was gradually removed, but the union, which was fibrous, was not sufficiently strong to maintain sixty degrees of abduction and the arm sagged to about forty degrees, in which position it now remains.

April 14, 1926, the elbow-joint was operated upon; the external condyle of the humerus was removed with the attachments of the extensor muscles and a flap of periosteum and bone was lifted from the front of the humerus about two inches above the elbow-joint and the condyle attached at this point by heavy catgut sutures. The arm was dressed in position of complete flexion and maintained in this position for three months until the parts had grown solidly together and then manipulation was begun to gradually straighten the arm at the elbow. This transplantation allows the patient to flex his arm completely, even when it is hanging down at his side, as there is a pull of the muscles from above the joint.

November 20, 1926, an osteotome was introduced into the carpal area on the outer side of the hand, destroying the carpal bones and their articulations, together with the cartilage on the lower end of the radius and ulna

and the proximal ends of the metacarpal bones. The hand was placed in the ulnar position as far as could be done and set straight with the radius and ulna. A plaster splint for this part has been worn until to-day (April 4, 1927), and now he is able to open and close his hand perfectly well and to grasp objects and hold the same, a function which he had not since the onset of his paralysis.

Operative procedures have therefore succeeded in giving this boy the ability to raise the arm about forty degrees from the side and to lift it upward and forward through the action of the scapula muscles; also to flex and extend the arm at the elbow and to grasp and hold objects with his fingers, all of which functions have been heretofore absent. As the pronation and supination of the hand are gone and the hand is in a position of pronation, it will be allowed to remain there.

PLEURAL CAVITY AND BLOOD STREAM INFECTION WITH BACILLUS WELCHII

Dr. Henry P. Brown and Dr. D. W. Kingsley (by invitation) reported the history of a man who was admitted to the Presbyterian Hospital, December 13, 1926, in the service of Dr. Edward B. Hodge. He had been shot in the left chest about half an hour prior to admission. Examination revealed a penetrating wound, just beyond the lateral border of the scapula. No wound of exit could be demonstrated. The heart was displaced to the right about three cm. and there were dulness and a suggestion of a friction rub over the base of the left lung. X-ray examination showed the bullet in the left chest, at the level of the tenth rib lateral to the spine and anterior to the chest wall. Two days after admission, the temperature rose to 103 and there was a general increase in the physical and röntgenologic signs of fluid in the chest. The blood showed 16,800 leucocytes. During the next eight days there was virtually no change in the general condition; but the temperature had fallen to 101 and the leucocytes to 9700. On account of increasing respiratory embarrassment, thoracentesis was performed on December 21 and 22. The aspirated fluid was dark and watery, 920 c.c. and 7500 c.c., respectively, being removed. Culture of the first fluid was sterile, but that of the second grew a non-hæmolytic streptococcus. As the latter sample had been inadvertently placed in a non-sterile container, this was thought to be contamination. The withdrawal of fluid afforded marked relief of symptoms. On the fourteenth day, after admission, the temperature suddenly rose to 105 and the patient became very toxic. The wound in the chest wall showed nothing to account for this. The chest was again tapped and 400 c.c. of fluid withdrawn, which upon examination showed a growth of bacillus Welchii and streptococcus non-hæmolyticus. Upon the advice of Dr. John Jopson, a rib resection was performed, for the provision of better drainage, and 300 c.c. more of fluid was removed. The operation was followed by a rather sharp rise in temperature and an alarming fall in blood-pressure (78 S-5 OD). A blood culture taken on the same evening was later reported positive for bacillus Welchii. Antitoxin was administered during the next six days in amounts totalling 360 c.c., of which 50 c.c. was given intrathoracically and 310 c.c. intravenously. Following the first administration of serum, the temperature fell by lysis from 106 to 100, with a concomitant improvement in the patient's general condition. Subsequent blood cultures failed to show any growth; but bacillus Welchii continued to be obtained from the thorac-

otomy wound. Inoculation of a rabbit proved the identity of the organism beyond question. The chest wound was treated by dakinization and recovery preceded normally, being complicated by the slipping of one of the tubes into the pleural cavity. Fortunately Doctor Brown was able to withdraw the tube and incidently the bullet, with the aid of the fluoroscope. The patient was discharged March 4, 1927, with the chest wound practically closed.

The unusual features presented by this case are:

1. The invasion of the blood stream by the bacillus Welchii which is said to occur very infrequently except immediately before death.
2. A low leucocyte count throughout the period of invasion.
3. The consistently low blood-pressure.
4. The beneficial effect of serum on an apparently hopeless case.

Dr. Henry P. Brown, Jr., said that the cause of the infection in the pleural cavity is not clear; if due to the bullet, he should have shown some infection of the muscles of the back but at no time was there evidence of such involvement. The organism was not recovered for fourteen days, at which time, communication between the pleural cavity and the chest wall had become sealed off.

Dr. Edward B. Hodge remarked that when the patient was seen two days ago, the wound was solidly healed and he was entirely well. The speaker mentioned in this connection the recent observations of Dr. Urban Maes, who reported some cases which he was unable to trace to soil contamination and found that woolen clothing, even if clean, very frequently carries bacillus Welchii. This opens up a new field, as to the possible source of such contamination in wounds.

SPONTANEOUS RUPTURE OF GALL-BLADDER INTO DUODENUM

Dr. Hubley R. Owen presented a man, age forty-five, who was admitted to the Philadelphia General Hospital, February 1, 1926, with the chief complaint of vomiting blood. January 30, 1926, while in bed the patient was awakened with severe abdominal pain, which lasted about an hour. He then vomited a large amount of bright red blood. The vomitus also contained food taken the night before. This was followed by profound weakness and sweating. There was no history of any previous attack relative to the stomach with the exception of considerable gaseous and acid eructations for two or three weeks prior to admission. On the morning of admission the stools were black and tarry. There was no history of loss of weight. The past medical history was essentially negative. On admission the temperature was 98, pulse –90, respiration –20. He was able to be up and about the ward, and did not look acutely ill. Abdominal examination revealed the liver palpable below the costal margin. No masses were felt. No points of acute tenderness. Blood Wassermann was negative. The blood count showed a mild secondary anæmia, with 17,800 leucocytes. X-ray examination resulted in a tentative diagnosis of duodenal ulcer, but suggested the possibility of a fistulous communication between the gall-bladder and the duodenum. At operation, February 11, 1926, the second portion of the duodenum was found attached to the gall-bladder, and there was a fistulous opening between the

gall-bladder and duodenum, the former was, however, normal in size and color. About six inches from the pylorus there were several broad bands of adhesions running across the duodenum. These were ligated and severed. The head of the pancreas was hard and nodular and at that time was thought to be malignant. The conus of the duodenum was considerably distorted and bound down with adhesions, which prevented proper evacuation of the stomach contents through the pyloric ring. Posterior gastro-enterostomy was performed. The patient made an uneventful recovery and was discharged from the hospital February 24, 1926. X-ray examination nine months after operation showed the gastro-enterostomy functioning and the fistulous communication still present between the gall-bladder and the duodenum.

PERFORATING JEJUNAL ULCER

DR. E. L. ELIASON presented two patients illustrating the above condition.

CASE I.—A man, age thirty-three, who in July, 1925, first began to have attacks of epigastric pain of a dull aching character which came on from thirty minutes to two hours after taking food. These pains were so distressing as to keep him from working, and would wake the patient from sleep about 2 A.M. when he would have to get up and take soda as these pains were relieved by taking food or by soda. March 8, 1926, the patient entered the University Hospital with the diagnosis of duodenal ulcer. He was operated upon March 29, by the reporter, at which time gastro-enterostomy and appendectomy were done. The ulcer was found and oversewed. The patient felt very well for about three months after the operation, during which time he gained weight and was free from symptoms. Then severe pain in the side radiating to the back and to the testicle developed. These pains had no relation to meals, were colicky in character and came on any time during the day and night. In August, 1926, the attacks became so severe that the patient was obliged to stop work. December 3, 1926, he again entered the University Hospital and was discharged on the 15th. At this time gastro-intestinal X-ray study was made and reported negative. Urinalysis revealed red blood corpuscles on two occasions. While in the hospital he felt better. On January 14, 1927, he was readmitted. Cystoscopic examination was negative for calculus. Patient was discharged ten days later, feeling better. On February 4, 1927, he had a sudden attack of pain in the abdomen, sharp, stabbing in character, localizing a little to the left of the umbilicus. This pain continued until the afternoon of the following day. Pressure on the abdomen as by leaning over a banister or chair gave some relief. He states that while doing this he suddenly felt something "pop" inside his abdomen, after which he had immediate relief. That night he felt weak and restless. The stools were tar-like in appearance. Fluoroscopic examination of the stomach revealed a normally functioning stoma. The opaque meal entered the jejunum but after progressing about two inches would stop and regurgitate into the stomach. A diagnosis of jejunal ulcer was made. Examination of the abdomen revealed slight but definite rigidity of the upper left rectus muscle. No tenderness noted. Peristalsis was slightly exaggerated. At operation the gastro-jejunostomy was delivered partially and with the finger inverting the anterior wall of the stomach, the stoma could easily be palpated. About two inches below the gastro-enterostomy an ulcer of the jejunum was found which was adherent at its outer side to the transverse mesocolon. By putting the jejunum on tension, it could be separated by blunt dissection

from the meso-colon until the ulcer was reached, at which site the erosion made an opening into the gut. It had eroded a small vessel in the transverse meso-colon from which the hemorrhage occurred. The meso-colon was dissected away enough to allow about one-half inch of jejunum distal to the enterostomy opening so that the opening could be inverted and oversewed. After a stormy convalescence the patient recovered and left the hospital in good condition, with no symptoms of a gastro-intestinal nature. Six weeks following the last operation, the patient was admitted to the hospital because of a hemorrhage from the bowel. This was bright red and probably came from near the anus. Sigmoidoscopic examination showed its possible origin to be hemorrhoidal.

CASE II.—M. M., male, age twenty-nine, first admitted to the Howard Hospital complaining of severe pain in the abdomen, associated with vomiting and weakness. His family physician had diagnosed the condition as due to a perforating duodenal ulcer. A laparotomy by the reporter disclosed a subacute perforation of a large indurated duodenal ulcer with a small abscess at the site. The ulcer was burned out with the cautery and a posterior gastro-jejunostomy of the anti-peristaltic short-loop type performed on May 27, 1922. The infection from the abscess resulted in a breaking down of the laparotomy wound which finally healed with a wide but solid scar. There followed sixteen months of freedom from symptoms when the patient was again admitted in Doctor Eliason's service suffering with the symptoms of a left abdominal catastrophe, having been seized three hours previously with severe knife-like pain in the left side of the abdomen just opposite the umbilicus. He was not nauseated nor did he vomit. On admission his temperature was 100, pulse 120, respiration 22. The abdomen showed board-like rigidity and was tender. The leucocyte count was 16,000. A diagnosis of ruptured jejunal ulcer was made and operation advised. At operation there was revealed a diffuse acute chemical peritonitis and a perforated ulcer in the jejunum opposite the mesentery two or three inches below the gastro-jejunostomy. The ulcer was cauterized and closed with tier sutures. The pylorus was occluded by double ligating with No. 3 kangaroo tendon. The patient recovered and left the hospital in good condition. From then until the present his health has been good and his gastro-intestinal tract has been kept practically normal by the regular use of alkalies. Examination last month revealed a normally acting stoma and a closed pylorus.

At operation both cases presented a much dilated, congested and thickened jejunum; both cases had a perforated ulcer in the distal loop and normally functioning stomata.

DOCTOR ELIASON added that ulceration at the line of suture or in the jejunum close thereto occurs almost exclusively after operation for simple disease, that is, ulcer in contra-distinction to carcinoma. In only one case in the literature (Axel Key) was the anastomosis performed for carcinoma. According to Moynihan the ulcer may be single or multiple, usually situated at the opening; it may be in the proximal jejunal loop but is usually in the distal loop. Jejunal ulcer may occur following any type of gastro-jejunostomy or it may occur primarily in the absence of any gastro-enterostomy, as was the case in a patient reported in the ANNALS OF SURGERY, 1926, by Barber. Barber's patient had had a gastric ulcer perforate twice before a

jejunal ulcer perforated. Van Roojen found it three times as frequent in the anterior type of anastomosis as in the posterior type. The frequency of occurrence in all cases as found by Deaver in a series of 3869 cases was 0.75 per cent. The vast majority of the cases reported up to 1921 showed the first symptoms between six and eighteen months, but three cases occurred within three days (Van Roojen). Leiblein in his study of seventy-nine jejunal ulcers found 30 per cent. perforated. Of the 70 per cent. chronic cases, fifty-five in number, eighteen required two or more operations. Moynihan reports a case that perforated five times. A review of 148 cases of gastro-jejunostomy for duodenal ulcer admitted to the Medical Service of the University of Pennsylvania Hospital, reveals three cases of supposed jejunal ulcer. Examination, however, found none proven.

MULTIPLE GIANT-CELL TUMORS

Dr. Emory G. Alexander and Dr. W. H. Crawford (by invitation) read a paper with the above title, for which see p. 362.

Dr. Ralph Bromer showed slides which illustrated the usual type of bone cyst, chronic cystic osteitis and giant-cell tumor. He considered Doctor Alexander's case as unusual in that it has a peculiar moth-eaten appearance of the bones and so is unlike the usual type of chronic cystic osteitis. Giant-cell tumors of the shaft are rare. One case, reported two years ago as a giant-cell tumor of the middle of the shaft was so classified by two pathologists who first saw the pathological sections but when sent to the Bone Sarcoma Registry, it was there classified as a bone cyst.

Doctor Ewing has said that this region is more productive of unusual types of bone tumors than any other. Dr. C. Y. White diagnosed this tumor as chronic cystic osteitis with giant-cells. The tumor has a narrow transverse diameter as compared with its length. The number of epulis type of foreign body giant-cells in the sections was greater than usual in cases of chronic cystic osteitis, but scarcely sufficient to warrant a diagnosis of giant-cell tumor.

At the International Radiological Congress in London, 1925, Kienböck, in a paper on the classification of bone tumors, drew attention to the so-called Engel-Von Recklinghausen type, otherwise known as osteitis fibrosa tumerosa cystica generalisata. In this type multiple giant-cell tumors occur with the usual changes of chronic cystic osteitis. It is also characterized by clubbing of the fingers and a marked translucent appearance of the phalanges of the hands. It seems that this case might be of this type.

The speaker asked Doctor Crawford, whether in reviewing the literature on this subject he had found anywhere a report of the occurrence of multiple giant-cell tumors with absolutely normal bone elsewhere than at the sites of the lesions. He could find none and Doctor Brower believes that Codman is right when he says that he is skeptical of the existence of multiple giant-cell tumors. Bloodgood thinks they occur in the proportion of about one in

25,000 cases. This case should probably be classified as one of chronic cystic osteitis with multiple giant-cells, probably an advanced stage of the usual chronic cystic osteitis or osteitis fibrosa cystica.

OBSTETRICS BEFORE AND AFTER LISTER

Dr. George M. Boyd, by invitation, read a paper with the above title. This paper was read in connection with the centennial of Lord Lister and consisted of a comparison between the pre- and post-Listerian eras in obstetrics. The essayist recalled that at one time it was a matter for serious consideration that all lying-in hospitals be closed, as the mortality from puerperal sepsis was so high that a woman going to such an institution to be confined, stood less than an even chance of surviving. The introduction of antiseptic methods into obstetric practise was followed almost at once by a reduction in the number of such cases to the point where " child bed fever " is to-day regarded in most instances as a direct reflection on the obstetrician. Doctor Boyd's presentation was profusely illustrated with lantern slides.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held April 13, 1927

The Vice-president, Dr. Frank S. Mathews, in the Chair

CIRRHOSIS OF LIVER—OMENTOPEXY

Dr. John Douglas presented a man, age forty-seven, who was presented before the Surgical Society two and a half years ago and the case reported in the Annals of Surgery, 1925, vol. lxxxii, p. 712, in which the details of the history and operation and comments thereon may be found. At the time of operation, which was an omentopexy, done under local anæsthesia, the prognosis appeared to be very bad. When previously presented it was only about one year after his operation. He is now presented three and a half years after operation and he is apparently in excellent health and doing heavy work. It is of interest that notwithstanding his apparent cure, there is an absence of the dilated abdominal veins which one expects to find after an omentopexy.

Dr. Ralph Colp said that several years ago he assisted in collecting a series of cases of omentopexy from the records of the Presbyterian Hospital. The results seemed to show that in the cases that had been tapped a number of times and then subjected to operation the result was poor, but in those tapped only a few times and then operated on the prognosis was fairly good. After reflection upon this subject in recent years, it has seemed to the speaker that as the collateral circulation in cirrhosis is usually great, and as occasionally these patients do recover without operation, that the small tab of omentum which is brought out so as to establish anastomosis with the epigastric vessels would seem to have little to do with the ultimate cure. In the case Doctor Douglas showed there is little evidence locally that anastomosis has taken place and that is another indication that the operation as such probably has little to do with the cure of these patients.

Dr. Robert T. Morris asked about the stage of the cirrhosis. The only good result he has obtained with omentopexy was when there was still some hypertrophy and in advance of replacement of parenchymatous connective tissue. Some time ago he devised a brush for removing endothelium from the surface of the liver. The brush has very short, stiff bristles and a curved back and handle. When the dome of the liver is thoroughly brushed the resulting adhesions allow of some blood and lymph circulation in addition to that given by omentopexy.

Doctor Douglas, in closing the discussion, said that undoubtedly the number of cases of cirrhosis cured or relieved by omentopexy is limited.

But as far as the collateral circulation is concerned, he had called attention to the fact that this man has very few large superficial veins. In doing the operation under local anæsthesia (for general anæsthesia is likely to cause an early exitus), he makes an attempt with the sharp edge of a knife to scrape off as much endothelium as possible where the omentum is attached and while few of these cases do improve or get well after operation, it must be a little more than coincidence that some do get well, such as this man, for instance. He was tapped every ten days and was desperately sick before operation. Replying to Doctor Morris as to the state of the liver, the cirrhosis was in the atrophic stage; the man had a hobnail liver, but only a moderate amount of involvement of the spleen.

CARCINOMA OF THE RECTUM

DR. JOHN DOUGLAS presented a man, age fifty-two, who was admitted to the Knickerbocker Hospital in December, 1926, with acute intestinal obstruction. Rectal examination showed a mass well above the prostate which appeared to be an annular carcinoma. December 20, 1926, a colostomy was done, under local anæsthesia, the sigmoid being pulled through a left rectus incision. This was intended as a permanent colostomy, a combined abdominal perineal resection being planned later. The patient was much emaciated and in poor condition, but by January 20, 1927, was deemed able to stand the second operation. A right rectus incision was done and the speaker was surprised to find that although the growth was palpable by finger in the rectum, it was sufficiently above the peritoneal reflection over the bladder to allow its complete removal with a restoration of continuity of the intestine. At the time of the operation, it was observed that a loop of small intestine had slipped through the space lateral to the colostomy but was not obstructed. This space was carefully closed. Subsequently, the colostomy spur was cut through with a Mikulicz clamp and on February 9 the colostomy was closed. It was of interest at this operation to find that with the finger of one hand in the colostomy above and the finger of the other hand in the rectum, the two fingers could be made to touch at the point of anastomosis where very little narrowing was present.

This case he presented to call attention to the fact that occasionally in a small thin patient, an annular growth which has not prolapsed from above, can be felt by rectum and still be above the peritoneal reflection allowing a resection of the upper rectum without a permanent colostomy; also to call attention to the not infrequent occurrence, or possibility of intestinal obstruction due to a loop of small intestine slipping through the opening lateral to the sigmoid at the point of colostomy. The speaker lost one patient several years ago from this cause.

Perhaps the chance of recurrence in this patient might have been minimized by a complete abdominal perineal resection, but no enlarged glands were present and his general condition was such that the more extensive procedure would have greatly increased the operative hazard.

CONTRACTURE OF ELBOW

DR. JOHN DOUGLAS presented a girl, age seven, who was admitted to the Knickerbocker Hospital, Out-patient Department, November 20, 1925, with a severe burn of the right arm. By the time the burn had healed and epithelialized, there was a contracture of the elbow preventing extension

beyond 90 per cent. A plastic operation was suggested, but permission refused by the parents. An apparatus (see Fig. 1) was applied, which in less than three months resulted in complete extension.

Also a boy, aged nine, who was admitted to the Knickerbocker Hospital, December 13, 1926, with a complicated fracture-dislocation of the elbow-joint. The upper end of the ulna was fractured, the head of the radius dislocated forward, and a fissure without displacement was present in the lower end of the humerus. The replacement of fragments was most effective in the position of acute flexion.

January 3, union was present but extension only possible to 100 degrees. The extension apparatus was applied and by March 3 extension was to 170 degrees.

Description of Apparatus.—Two pieces of ¾-inch board 4 inches by 7 inches are united at the ends with a heavy "screen door spring" with a pull of four to five pounds, and covered with heavy felt. Two ¾-inch straps are then fastened to each piece of board to attach apparatus to the arm and forearm. Heavy felt is attached to the two end straps to act as cuffs. This is applied to the flexed extremity and the spring makes a constant pull in the direction of the extension. In the beginning, if painful, the splint may be applied for only a few hours at a time. Later it can be worn practically continuously without pain until extension is complete. It is necessary to use the ¾-inch board on account of the size of the spring attachment. (Fig. 1.)

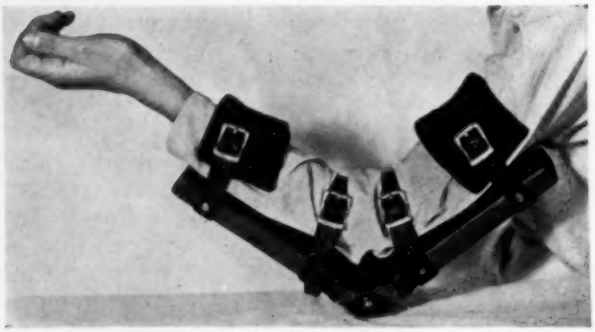

FIG. 1.—Apparatus for gradual extension of elbow-joint.

DR. SETH M. MILLIKEN said that in this contracture of the elbow due to burn, the contracture is of the skin due to the scar and is very narrow. Resistance of the scar is relieved by the development of the surrounding soft parts which give and while that is a contracture due to a scar of the skin, recovery in those cases is very rapid and spontaneous in children. Doctor Milliken said he wished to differ with the diagnosis in the second case; he did not think it was a contracture about the elbow-joint; it is a contraction of the flexor muscles of the forearm. The arm was put in the Jones position and the muscles hold it in flexed position. A child will always regain full extension if left alone because the muscles gradually relax. They have been held up and they are lame when first released, but they will come down. The boy seemed to have bony limitation at present amount of extension. If there is no interference by bone about the joint, complete extension supervenes spontaneously.

DR. HENRY H. M. LYLE said that the splint presented by Doctor Douglas was simple and efficient. He had made extended trials with several of the best known internal splints but has abandoned them as being unsatis-

factory. They are mechanically bad and physiologically unsound. From a mechanical standpoint all splints applied on the internal aspect of the arm must of necessity have a very short upper arm piece, as the distance between the elbow crease and the axilla leave but little room for a suitable mechanical leverage as compared with the splint applied to the outer arm. Internal splintage to overcome a contracture of the elbow is contrary to sound physiological and psychological principles. For instance, if you place a weight in the palm of the patient's hand he involuntary flexes the arm to sustain the weight—that is his natural reaction. Now if you attach the same weight to the back of the hand the natural reaction is to extend the arm. Try this experiment on yourself and be convinced. The power to heal is the property of all living tissue, but the power to recover function—the function of muscles and joints is the property of the patient's will and brain. Doctor Douglas' splint is simple, efficient, and based on sound physiological principles.

Doctor Douglas, in closing the discussion, said that when the girl came from the Out-patient Department the skin was contracted; it was not the subcutaneous tissues. There was a web across and there seemed little possibility of straightening it out without operation. It might have been done in time but not so soon by other means as by this splint. As to the boy, Doctor Douglas was willing to acknowledge that contracture was not the best term to apply to this case of elbow-joint fracture, but he could not think of a better one and so had let it stand. As to shortening of the flexor muscles of the arm, the speaker did not think this contracture was due to that, but to a thickening and contracture of the capsule and fibrous tissue around the true capsule of the joint. As to the belief that the present limitation is entirely bone, two months ago it felt just as bony as it does now, but extension has increased 60 degrees.

BANTI'S DISEASE FOUR YEARS AFTER OPERATION

Dr. John Douglas presented a boy, age fourteen, who was admitted to the Knickerbocker Hospital, December 9, 1922. He gave a history of having had two hemorrhages, eight hours apart, from the stomach the day before admission. Each hemorrhage was said to consist of clotted blood to the amount of one pint each. He had bled from the gums at times during the previous year and had suffered from headache for two weeks previous to admission to the hospital. His spleen at this time was palpable. His red blood count was 3,000,000; hæmoglobin 54 per cent. with 10,000 leucocytes and 89 per cent. of polymorphonuclear cells. His stools showed blood by the benzedin test, but no gross blood was present. On December 23, two weeks after admission, his blood count had dropped to 2,000,000 with 42 per cent. of hæmoglobin, the leucocyte count being 6000 with 67 per cent. of polymorphonuclear cells. He was transfused on December 29 and again on January 6, after which his blood count was 3,650,000 with 65 per cent. of hæmoglobin. On January 8, 1923, a splenectomy was done.

The spleen weighed fourteen ounces and the liver was decidedly cirrhotic in appearance, but no fluid was present in the abdomen. Following his operation, he had no further hemorrhages and his red blood count and hæmoglobin rapidly improved. In six weeks his hæmoglobin was 60 per

cent.; red cells 4,720,000. Nine months later his hæmoglobin was 80 per cent.

During the four years since his operation, he has been followed but has always been somewhat anæmic, although he has taken iron and arsenic at intervals since then. A recent blood count showed 3,600,000 red blood cells; 75 per cent. hæmoglobin; 11,600 leucocytes with 70 per cent. polymorphonuclear cells. The eosinophiles were 4 per cent.

He was born in Porto Rico and a search of the stools for ova showed nothing.

Concerning the diagnosis in this patient, the pathological examination of the spleen showed increased fibrosis with diffuse overgrowth of all the tissue elements found in the spleens of splenic anæmia. The spleen weighed, after the blood had drained out, 476 grams—there had been gastric hemorrhages—all of which supported the diagnosis of splenic anæmia. In addition, there was a markedly cirrhotic change in the liver, which would appear to be a further progress in the pathological condition known as splenic anæmia to the more marked pathological condition known as Banti's disease, although this had not advanced to the development of ascites.

This patient then would belong in those cases of the adult type of splenic anæmia in children, which seem to differ somewhat from the splenic anæmia of infancy, or Von Jach's disease. In the latter there is a leucocytosis of from 10,000 to 100,000, with a lymphocytic prominence, more marked blood destruction with the hæmoglobin sometimes as low as 25 per cent., usually normoblasts and frequently megaloblasts. Usually the liver is not involved.

It is of interest that the blood picture in this patient still shows a moderate anæmia four years after his splenectomy—as if some toxine, notwithstanding his splenectomy, was still affecting his hæmopoietic system. His last blood examination showed 4 per cent. eosinophilia, but stool examination was negative. He has had no further hemorrhages, although Mayo in an article published in 1921 stated that hemorrhages frequently continue after splenectomy and that in 8 out of 71 patients splenectomized for splenic anæmia, death resulted from subsequent hemorrhages in the next ten years after operation. There has also been no evidence of symptoms due to the liver cirrhosis which was marked four years ago at the time of operation.

CARCINOMA OF FLOOR OF MOUTH—RECURRENCE IN OPPOSITE SIDE OF THE NECK EIGHT YEARS AFTER OPERATION

Dr. John Douglas presented a man, age sixty-one, who was admitted to St. Luke's Hospital, December 27, 1918. He then complained of a "sore" at the posterior border of the left edge of the tongue at the junction with the mucous membrane of the floor of the mouth. This had been present for four years. It had been treated with nitrate of silver several times, and burned with the electric cautery two or three times. Four months previously a piece had been excised for examination—findings unknown. Some enlarged glands were felt in the sub-maxillary region. December 30, 1918, the lingual artery was tied, the glands from the left side of the neck removed, and an area, consisting of the left border of the tongue, part of the floor of the mouth posteriorly, and the anterior pillar of the fauces, removed. The growth showed squamous-cell epithelioma. There was no carcinoma in the glands, but one was tuberculous. On April 8, 1919, he returned with a small mass of recurrence at the junction of the anterior pillar of the tongue. This was excised on April 9, 1919. He was then treated with the X-ray for the next three years and kept under observation.

In March, 1927, eight years after his first operation, he was examined and two good-sized nodes were felt in the right side of his neck. Careful examination of the throat and mouth showed nothing. His teeth had all been removed. March 22, 1927, a block dissection was done of the right side of the neck. Two of these glands were found to be carcinomatous.

This patient is shown as a late recurrence in the distant regional lymph-nodes eight years after operation without local recurrence; and to bring up a discussion of how extensive dissection of lymph-nodes should be in these growths in the tongue and in or about the mouth.

DR. ELLSWORTH ELIOT, JR., said that the fact that the glands are liable to become involved on the opposite side has been recognized for many years as attributable to crossed anastomosis. It is quite possible for metastasis to occur on the side of the neck not occupied by the original growth. The point of particular interest is the long interval that has elapsed since the operation and the development of secondary metastasis. Any interval of more than two or three years is very remarkable and an interval of seven years is worthy of comment. It merely goes to show that glandular involvement in carcinoma can remain quiescent for a considerable time, even in carcinoma of the tongue and floor of the mouth.

DOCTOR DOUGLAS rejoined that it is always advisable to remove the primary growth before removing the glands. He learned this in one case he operated on two or three years ago when he removed the glands first and the tongue a short time afterward. Three months afterward the patient had a palpable gland, which was carcinomatous, on the opposite side of the neck. A block dissection on this side was done and fortunately, up to the present time, there has been no sign of recurrence. Doctor Douglas wondered if it were possible to have a definite set of rules in these cases. He had always thought that when removing a growth in the mouth or on the lip the wise procedure was to remove all the regional glands on that side of the neck by bloc dissection at the same sitting, or at a subsequent sitting to the removal of the primary growth. If the pathological report shows that the glands are involved, it is wise to also remove all the glands on the opposite side. But in this case the glands on the side of the lesion were not involved and the man came back eight years later with recurrence on the opposite side, which would make this rule as valueless as many rules are.

CARCINOMA OF STOMACH

DR. JOHN A. MCCREERY presented a man who was admitted to Bellevue Hospital in December, 1919, in his fiftieth year. He gave a history of epigastric pain of eighteen months' duration, pain coming on an hour after meals, relieved by carbohydrates, increased by taking heavy or greasy foods. There had been repeated free intervals of two or three weeks' duration. For six months before admission pain had been more continuous and vomiting had been a prominent factor, coming on an hour after eating anything but soft foods. He had lost thirty-five pounds in weight, and was unable to work because of loss of strength. On admission he was cachectic in appearance. There was a movable epigastric mass with a dilated stomach.

Test-meal showed a total acidity of 35, no free acid, no blood. X-ray was not taken.

At operation a pyloric tumor with apparent metastases to the glands of the omenta and to those overlying the pancreas was found, and a partial gastrectomy by the Billroth II method was performed. Examination showed an ulcer measuring 4 by 3.5 cm., the wall and floor of which showed infiltrating masses of epithelial cells, arranged in adenomatous strands, extending to the serous surface. The glands were not involved.

The man's convalescence was uneventful, and he has remained in good health without evidence of recurrence to the present time, seven years and four months after operation.

At operation he was regarded as an unfavorable case in view of his general condition and the extent of apparent glandular metastases.

He is shown as a case in which the size of the mass and the apparent involvement of the lymph-nodes made radical operation a somewhat questionable procedure. However, as Doctor Whipple pointed out in his discussion of Doctor St. John's recent paper on Carcinoma of Stomach, neither of these should be deciding factors in determining the advisability of a radical operation. It seems worth while to attempt the removal of any tumor which is localized to the stomach and to adjacent glands, and while the resulting cures are still few, one is justified in reporting them with the hope of impressing on the general practitioner the fact that carcinoma of the stomach is not always a hopeless condition.

Dr. Allen O. Whipple said that it was of some interest that in a series reported by Doctor St. John, last winter, of resection for carcinoma of the stomach, had the presence of a large mass with enlarged nodes taken to be metastases been looked upon as a contra-indication for resection and the patient allowed to go without radical operation, the results in patients surviving over five years would not have been as high as 15 per cent. All of these cases showed a large mass with enlarged lymph-nodes, and in one of the cases operated upon by the speaker, he very nearly gave it up as inoperable. The main point in determining whether or not the growth is to be resected is the presence or absence of metastasis in the liver and the extension of the growth into adjacent structures such as the pancreas. It is very difficult to judge on the table by the size of the growth whether or not it is carcinoma.

ULCER OF STOMACH

Dr. John A. McCreery presented a man of thirty-eight years, who was admitted to Bellevue Hospital, October, 1919, with a four-year history of gastric ulcer. At operation an ulcer was found high up on the lesser curvature. Resection did not seem feasible and the ulcer was subjected to cauterization and a gastro-enterostomy done. The symptoms were relieved but returned two and a half years later, lasting about a month and disappearing when some business trouble was straightened out. At this time an X-ray report of pre-pyloric ulcer was made but not confirmed at a subsequent examination. A test-meal at that time shows a total acid of 70, with 30 free acid, as compared with 25 total and no free immediately after operation. For the past five years aside from a short period of discomfort a year ago, he has been in good condition. X-ray taken a year ago showed no evidence of ulcer.

In that he has had symptoms since operation, he cannot be considered a cure, but his relief has been very considerable, and he is presented as a case in which the Balfour operation has given a satisfactory result when resection was not possible.

Dr. Seth M. Milliken said that in 1919 he operated on a stomach and found a large ulcer on the posterior wall well over on the left side and adherent to the tail of the pancreas. The ulcer was carcinomatous macroscopically, had a crater measuring three-fourths of an inch and a total diameter of over one and a half inches. It seemed impossible to do anything but a gastro-enterostomy, which was performed. The patient made an uninterrupted recovery and gained 40 pounds in weight. Diagnosis made by X-ray before operation by Steiner was ulcer. The patient subsequently had no stomach symptoms until three years afterward, when she complained of pain and a good deal of bile after eating strawberries. She was advised to discontinue eating this fruit and thereafter had no further trouble. She died last summer from a cardiac condition. Doctor Milliken considered gastro-enterostomy has proven to be of great benefit in these high ulcers of the lesser curvature.

Doctor McCreery, in closing the discussion, referred to some work as yet unpublished that had been done at Bellevue by Doctor McWhorter. He had been studying autopsies of cases of malignant disease with particular reference to metastases. In 170 autopsies of cases of carcinoma of the stomach, 24 (14 per cent.) showed no evidence of metastasis. This would indicate that there was a very considerable percentage of cases in which a cure by operation might be hoped for and strengthened Doctor McCreery's belief that all cases without obvious metastases should be explored as in Doctor McWhorter's series some of the cases with large lesions in the stomach showed no extension beyond that organ.

SEPARATION OF LOWER FEMORAL EPIPHYSIS

Dr. John A. McCreery presented a girl of thirteen, who was admitted to the First Surgical Division of Bellevue Hospital, December 24, 1926. Shortly before admission while in a crowd, she slipped and fell, and on getting up was unable to bear weight on right leg. No more accurate description of the injury could be obtained. On examination there was distortion of normal contour of knee region, with bony resistance in the popliteal space, suggesting posterior displacement of the lower end of the femur. There was 2 cm. shortening of the extremity. There was no evidence of injury to nerves or blood-vessels.

X-ray showed a dislocation of the lower femoral epiphysis, which lay with its upper surface in contact with the anterior surface of the lower end of the diaphysis.

Reduction was accomplished without difficulty by traction and flexion accompanied by direct pressure on the epiphysis. The dislocation tended to recur when the leg was straightened, so the knee was immobilized in acute flexion in a plaster cast.

This was kept on for five weeks. When removed active extension was

limited to 90 degrees, but this rapidly increased with active use, and function was complete when patient was discharged eight weeks after injury.

While dislocation of this epiphysis is described as a relatively common injury, one author quoted by Speed, speaking of it as the most common epiphyseal dislocation, it has been rather a rarity on the Bellevue Service, there having been only three cases admitted to the adult services in the past five years.

In Doctor Burdick's report of end results of fracture of the femur in children, read before this society in 1923, six cases are listed as lower epiphysis, but in none of these was there displacement, and there have been no traumatic cases with displacement on children's service since that report.

In the two cases not reported operation was necessary, either to obtain or to maintain reduction. In one of these there was 2 cm. shortening two years after the accident, while in the other no shortening was noted after eighteen months. In the present case it is too early to say whether or not growth will be interfered with, although it seems that there is generally some difference in growth after similar injuries.

The case is reported because it is a comparatively rare condition in the large number of traumatic cases admitted to Bellevue Hospital.

FISTULÆ OF SMALL AND LARGE INTESTINE

Dr. Ellsworth Eliot, Jr., read a paper with the above title, for which see page 406.

Doctor Eliot also presented a woman from whom eleven years ago a uterine tumor was removed by another surgeon. This was supposedly a myomectomy as menstruation continued to be normal.

Early in 1924 this woman was confined to bed for a period of six weeks by an attack of most severe pain, referred to the lower part of the abdomen, extending equally to either side from an area of maximum intensity just below the umbilicus. It was accompanied by chills and fever. On recovery, after an interval of about one month, she was again confined to bed for a period of six weeks by an attack marked by vomiting, severe pain in the lower rectum, and persistent diarrhœa. During the ultimate convalescence she was partially incapacitated with occasional attacks of pain and fever and a continuance of the rectal condition. In September, 1924, examination revealed a smooth elastic tumor in the lower abdomen, more marked on the right than on the left side which, on bimanual examination was found to be fixed in the pelvis. The overlying abdominal wall was prominent, reflecting the outline of the tumor, and was free from rigidity and marked sensitiveness.

On operation an extensive abscess, extending down into the pelvis more deeply on the right than on the left side, was opened. It was entirely walled off from the peritoneal cavity by dense adhesions that presented no line of cleavage. The uterus anteriorly was obscured in the thick wall of the abscess cavity.

Since the operation a sinus, changing its position from time to time, has persisted in the abdominal scar. In February, 1925, it was injected with bismuth by Doctor Stewart and was then found on "X-ray" to communicate with the cavity of the small intestine, although no gas or intestinal contents were noted until January, 1926, and then only in small, intermittent, amounts.

The discharge has steadily decreased, although in June, 1926, a secondary abscess developed on the right side and was opened by Doctor Mathews.

Shortly after the first operation, a bloody discharge, preceding each menstrual period appeared, and continued for three days, to be followed by the usual vaginal flow for two days longer.

Latterly the sinus closed for the first time, remaining closed for a fortnight. The discharge is now at a minimum and contains no gas or intestinal contents. The abdominal scar becoming constantly more depressed is an indication of the ultimate healing of the sinus.

Dr. Robert T. Morris said there were one or two points requiring emphasis. In the first place, if the inner opening of the fistulous tract is far enough away from the abdominal wall, plastic exudate will contract the walls of the fistula slowly but surely, so that spontaneous cure will occur as a rule. In cases in which there had been gangrene of the appendix in the early days of that surgery, the cæcum was sutured to the abdominal wall by some surgeons in order to ensure safe drainage. The opening was so near to the surface that walls of the short tract could not contract well. If the cæcum was carried away from the abdominal wall and exudate allowed to form about a drain that wall would contract and close the fistula spontaneously. Some will disagree with Doctor Eliot's idea of burying the stump of an appendix. The cæcum may balloon and cut out a constricting suture. Furthermore, such a suture makes an anæmic area that is vulnerable to infection for a few days. Another important recourse and one that should have been included in a discussion of this subject is the use of Beck's bismuth paste. The speaker recently had a case like the one described by Doctor Eliot with a large ovarian abscess. A Mikulicz's apron with packing had to be used and when that was removed a fistula followed. He did not know if it was from the ileum or the colon. A trial of Beck's paste was made, although this was not expected to suffice because there was discharge of mucus; but it was a success. One injection of Beck's paste was enough for that case. Beck's paste works remarkably in so many fistulas as well as in sinuses that it seemed to Doctor Morris one should ever have it in mind to be tried out at any rate.

Dr. Charles Gordon Heyd concurred in Doctor Eliot's opinion that intestinal fistulæ had had insufficient study and a very doubtful classification. In his own personal experience he had been most impressed with four types of fistulæ: (1) Those occurring from perforation of a marginal ulcer into the colon; (2) those occurring between pelvic abscesses, tubes and the sigmoid; (3) those occurring between gall-bladder and duodenum, and (4) the common variety that occurs after gangrenous perforating appendicitis.

Nothing can be more devastating or formidable in surgery than the presence of a gastro-jejunal-colic fistula. The amount of surgery that may be necessary is quite extensive involving the closure of the stomach and jejunum and the resection of the colon. A case recently was admitted to the Post-Graduate Hospital, eight years after a no-loop gastro-enterostomy was performed. The patient's clinical history was interesting in that immediately after eating he had a colliquative diarrhœa, with pain entirely to the left of the midline and extending down into the hypochondrium. At operation

the anterior wall of the stomach about five cm. proximal to the pylorus was adherent to the under surface of the former laparotomy scar, with the result that there was a partial gastric angulation. In addition, the pylorus and duodenum were adherent to the under surface of the liver. The pylorus, however, was apparently patent. Adherent to the duodenum was an infected gall-bladder containing about twenty moderate-sized calculi. It is interesting to note the rather frequent development of gall-stones after gastric surgery, as certainly these stones were not present at the previous operation. Further support of the development of gall-stones after gastric surgery is the case that Doctor Heyd presented before this Society a year ago, in which it was demonstrated that gall-stones had formed in approximately eighty-five days, after a gastro-enterostomy. To revert to the patient under discussion, upon elevating the transverse colon upward and to the left, it was found that the gastro-enterostomy stoma was slightly contracted with the jejunum adherent to the transverse colon and a fistulous connection between stomach, jejunum and transverse colon. With the patient in the upright position the distal loop of the jejunum beyond the fistula formed an angulation which would have the effect of diverting almost the entire gastric contents into the transverse colon. Four distinct surgical procedures were necessary: (1) The taking down of the gastro-enterostomy; (2) closure of the gastric defect; (3) closure of the jejunal defect, and (4) resection of the transverse colon.

There is apparently no way of shortening the various procedures necessary in this type of case. The mortality is necessarily high. The technical difficulties of this type of fistula is only equaled in Doctor Heyd's experience by those that occur between the Fallopian tubes and the sigmoid. Interesting from the mechanical point of view are the fistulæ between duodenum and gall-bladder. In the last year he has had two such cases and in one the mechanism was that of a perfect ball valve. The patient would have an acute attack of cholecystitis, due to a large calculus within the gall-bladder, which would block the fistulous opening between gall-bladder and duodenum. After a variable period the stone would be dislocated and bile would be delivered from gall-bladder to duodenum with an immediate cessation of symptoms. At operation a single large calculus, five cm. in diameter, was obtained and little difficulty was experienced in closing the duodenal defect. Fistulous orifices in the duodenum heal, on the whole, kindly and technically are not of so great importance as are the fistulæ that occur from the opening of a jejunal stump following resection. Doctor Heyd's personal experience coincides exactly with that of Doctor Eliot in regard to fecal fistulæ in acute perforating appendicitis. He recalls but a very few cases where the appendix was amputated and the stump inverted that developed a fecal fistula of any importance. In fact, almost all of the fecal fistulæ due to appendicitis close spontaneously if left alone, unless there remains a portion of infected appendix, free fecoliths or secondary abscess between intestines and cæcum. It is usual to leave this type of fecal fistula without packing, and provide ample drainage with rubber tissue. It

is surprising what large defects in cæcum will heal kindly and close except for the post-operative hernia. Doctor Heyd was inclined to believe that there were no set rules for the treatment of intestinal fistulæ and each case must be decided upon its merits.

Dr. Theodore Dunham reported the case which came under his care some years ago. A young woman upon whom another surgeon had, a few months previously, performed a laparotomy. All was well except for a sinus in the lower abdomen. A little pus exuded from the sinus, but there was no escape of fæces or gas. The sinus was tortuous and could not safely be explored by probe. With the hope of disinfecting the sinus and so bringing about healing, Doctor Dunham drew a solution of iodoform in ether into a syringe and injected it into the sinus. The ethereal solution left the syringe with a somewhat surprising readiness and vanished in the sinus. There was no local distress, but soon the patient spoke of feeling somewhat faint, her breath took on an odor of ether and she eructated gas smelling of ether. She did not lose consciousness, the feeling of faintness passed and in perhaps half an hour she was feeling herself again. This treatment made it clear that the sinus communicated with the intestine. The sequel was a happy and an interesting one. The sinus closed and remained healed without further treatment.

Dr. Walter M. Brickner said that in the case presented by Doctor Eliot, according to the history the patient had a myomectomy performed and some time afterward developed a pelvic abscess and then an intestinal fistula from which blood escaped at each menstrual epoch. Doctor Eliot gave no explanation of this phenomenon nor did he give a cause for the abscess. It occurred to the speaker that both could be explained by the hypothesis that at the time of the myomectomy the endometrium was surgically invaded and an endometrioma of the intestine resulted. An endometrioma will penetrate the tissues; in this case by perforating the intestine it could cause the pelvic abscess, and leave an intestinal fistula through which it would bleed at each menstrual period. If this did not take place then one must assume in Doctor Eliot's patient that the abdominal fistula communicates not only with the intestine, as shown by the röntgenograms after bismuth injection, but also with the uterus or a tube, and of this the röntgenograms give no suggestion.

Dr. John Douglas said that the determination of the etiology of fistula arising from causes other than these due to the appendix is often very difficult and is, of course, of importance in deciding the nature of the treatment. Doctor Douglas had in mind two cases. One, a man, was admitted to Bellevue with several fistulæ; he had been operated on for double hernia and was finally brought to a hospital here in New York and operated on for fecal fistula, but unsuccessfully. He was then transferred to Bellevue. He had two or three openings in the abdominal wall and another perineal opening which leaked fæces. His condition was dreadful and the case looked hopeless, but it was decided to operate. After doing a cæcostomy an exploratory was done and an old strangulated femoral hernia was found; part of the gut

wall was fixed in the femoral ring and had allowed feces to leak from there. Two other openings were found in the sigmoid. Resection of the intestine with closure of the cæcostomy resulted in the man getting well. Another case was that of a man operated on after a gunshot wound of the abdomen in another city. He was sent to Bellevue with obstruction of the descending colon and was operated on by one of the staff. Resection seeming impossible and as obstruction was present, an ileo-sigmoidostomy was done. He had a stormy convalescence and shortly afterward developed a fistula. Most of the intestinal contents escaped and the abdominal wall was badly eroded and bismuth enemas immediately came through this fistula, so the assumption was that the ileo-sigmoidostomy had broken down. Finally, it seemed that something had to be done, and on dissecting the fistula it was found that a loop of the small intestine had become pinched in the abdominal wound and all that was necessary to cure him was to sew up a little hole in the small intestine. These two cases were cited to show the different possibilities one has to face in closing a fecal fistula.

Dr. Seward Erdman said that the formation of a combined external fistula, communicating both with intestines and uterus, somewhat similar to Doctor Eliot's case, had occurred at the New York Hospital. The patient was a colored woman, operated upon for a large ruptured tubo-ovarian pelvic abscess, and drained both abdominally and by vagina. Death occurred after three weeks and post-mortem examination revealed a fistulous tract which communicated with the ileum and with the uterine cavity. Whether this was due to infection and sloughing of the uterine wall, or to pressure of drains was never decided. Had she lived, it is possible that menstruation might have appeared through this fistula.

Dr. DeWitt Stetten thought that drainage should be emphasized as an important factor in the etiology of fecal fistula. It has always been his custom in abdominal drainage to use a cigarette drain consisting of a rubber dam tube with a strip of gauze running through. He has always felt that this type of drain was the most efficient and at the same time the most innocuous. In the past few years he has, however, had two cases in which he was sure the drains were the cause of a resultant fecal fistula which developed after their removal. He believes that the combination of damage to the intestinal wall from suppuration and erosion, from even a soft cigarette drain, causes the fistula, but, he asks, how can this be avoided? He does not believe in removing the drains too soon, feeling that they should be left in place long enough so that a definite sinus tract can form and so that subsequent retention will be avoided. His practice has been not to touch the drains for at least a week, unless there is some special indication for earlier removal. He admitted that it was quite possible that in the two cases cited, the drains may have been left in a trifle too long for those particular cases.

Dr. Hugh Auchincloss said that there are so many causes for these fistulæ that it is hard to analyze them. One thing that has helped in several

cases in the treatment is suction; he was in despair regarding one very sick case with a small intestinal fistula high up and happening to see a flat soft sea sponge in a druggist's window conceived the idea of making a hole in the middle, using this for the suction tube and utilizing it to take up the excess fluid as it gushed forth. The skin had become excoriated in forty-eight hours. The sponge was a great help in keeping the intestinal contents away from the skin. Drying the wound was another great help by means of electric light lamps. Another point about which Doctor Auchincloss wished to speak was the occurrence of fistula following the division of adhesions. These, if of any length of standing, are much stronger than the intestinal walls and trying to separate them by force will result in trouble. The adhesions should be divided by sharp dissection first with a knife or scissors, and blunt dissection subsequently and only with greatest gentleness.

Dr. Frederic W. Bancroft said that one of the means of preventing fecal fistula is drainage of secondary pelvic abscess following appendicitis either through the cul-de-sac or through the rectum. If an abdominal approach is made, however, the adhesions of the intestines are sometimes very dense and in attempting to free them frequently the bowel wall is injured and a fistula results.

He has used drainage through the anterior rectal wall for pelvic abscess in a considerable number of cases and has seen no ill results from this procedure. It is very easy to do and needs only a primary anæsthesia.

The tube is usually removed about the fifth day, and in only one case has he seen a secondary accumulation of pus following its removal.

Doctor Eliot said in answer to Doctor Morris regarding the use of Beck's paste, he had no opinion because he had never tried it. But he did believe in the efficacy of the injection of stimulating solutions. The subject is indeed one with many different angles. As regards duodenal fistula, he quoted the writer of a recently published essay who collected a number of cases, about seven in all, of which five healed spontaneously. In many fistulæ the tendency is to heal spontaneously. Doctor Morris had stated that without the use of the purse-string suture he had never seen a case of fecal fistulæ. The late Doctor Weir was in the habit of using plain catgut in the ligation of gangrenous and infected appendices without any accident. Yet the speaker has notes of half a dozen cases of fecal fistula that followed that method of treatment. Since 1902 he had buried the stump with a purse-string suture of absorbable material and the incidence of fecal fistula had been very much less. Where there has been occasion later to open the peritoneal cavity for another condition it has proved difficult to identify the site of the appendix stump. The purse-string suture has never done any harm, in the speaker's experience. Answering Doctor Bancroft's comment, Doctor Eliot said he had never had any experience in opening a pelvic abscess by rectum. The German school did that about twenty-five to thirty years ago and reported success in their periodicals. The speaker did not consider it a difficult matter to orient and drain a pelvic abscess without harm

to the sigmoid through the suprapubic route with satisfactory results. Regarding drainage, Doctor Eliot said he had given up using the cigarette drain because it had blocked discharge and had substituted a flexible rubber tube with a strip of gauze running through it. This drain is taken out at the end of the second day and a fresh one introduced. Daily replacing of the tube follows and at the end of a week its use may frequently be suspended. The period of abdominal drainage should be curtailed as far as possible. In regard to Doctor Stetten's experience, the continued use of a cigarette drain for a week might predispose to the development of a fistula, especially if it were near the line of visceral suture. In all these fistulæ the most difficult one to deal with is a fistula due to a gunshot wound of the large intestine; the speaker had tried to emphasize, in discussing radical treatment, that one should do the anastomosis as close to the site of the fistula as possible. Ileo-sigmoidostomy is simple but an anastomosis between the transverse colon and the sigmoid, if feasible, is much preferable. The resection of the fistulous tract after the anastomosis has been found to give generally good results.

BRIEF COMMUNICATIONS

ILEO-CÆCAL CYSTS

Cysts of the intestinal wall at the ileo-cæcal angle, by reason of a distinct pathology and a definite symptomatology, merit a place in surgical literature. A consideration of the few cases that have been reported leads to the conclusion that the rarity of the condition has been the reason for its lack of recognition as a surgical entity.

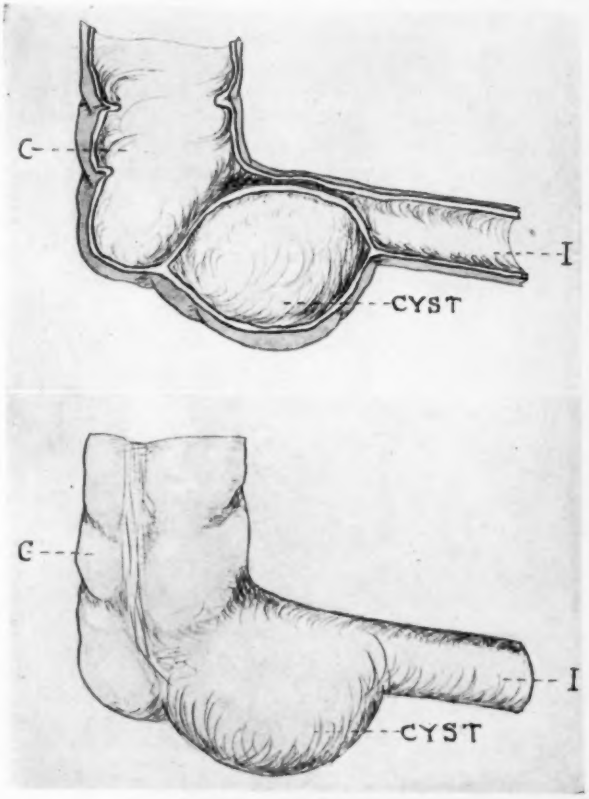

Fig. 1. Ileo-cæcal cysts.

Frankel, in 1882, reported an autopsy on an infant that died after three days of acute intestinal obstruction and described clearly a cyst in the wall of the intestine which spanned the ileo-cæcal valve and was the cause of death. In 1900, Sprengel reported a case in a girl of fifteen who had experienced obstruction symptoms for four years and was submitted to operation during an acute period with a similar finding. Sporadic cases to a total of not more than ten have reached the literature up to the present, all exhibiting a constancy of location, and a symptomatology of acute obstruction which, in a majority of cases, was diagnosed as intussusception. A typical case history, and one that corresponds to our own, is that of the case of G. W. G. Bryan: An infant with acute intestinal obstruction and a right lumbar tumor, gave an operative finding of an antimesenteric cyst of the ileum, the size of a tangerine, with one-third of the cyst in the wall of the cæcum and the edges of the ileo-cæcal orifice constricting the cyst. Being judged not removable by dissection, it was treated by marsupialization and at a later stage resection. A muscle layer was demonstrated in the outer wall.

Sir Arthur Keith, in studies upon a preparation of a full term still-born

child in the Royal College of Surgeons Museum, and one other case, that reported by H. F. MacAuley, found a mucous lining and a muscular coat and concluded that these cysts are embryonic extensions from the bowel, with a predilection for ileo-cæcal location which he was at loss to explain. The view, that these structures arise from vacuoles or diverticula in the developmental period and are later cut off from communication with the lumen of the intestine, has been reviewed thoroughly by T. A. Shallow.

CASE REPORT.—No. 37,610, Rochester General Hospital. E. C., female, age seven months, experienced an acute onset, three hours before admission, of pallor, vomiting and crying apparently due to pain. Throughout pre-operative period there were short periods of remission followed promptly by sharp recurrence. There was no other history except that the child had been very constipated from birth and that a smaller stool than usual had been observed twelve hours pre-admission. Repeated enemata brought no relief, blood or fecal matter. Physical examination showed only a tense, tender, movable tumor in right lower abdomen, which was distinctly "sausage-shaped" and measured about one by two inches. Operation under a confident diagnosis of intussusception disclosed a discrete cystic formation in the anti-mesenteric intestinal wall extending across the ileo-cæcal junction and evidently causing obstruction. The cyst was opened, a quantity of thin colorless fluid evacuated and lost and the lining membrane removed as completely as possible. Since the cystic structure could not be removed without jeopardizing intestinal wall, the outer layer was trimmed to permit of being sutured down in exact approximation and a normal appendix removed. Recovery was prompt and uneventful, and there has been no complaint in the ensuing six months.

The pathological report stated: Specimen shows a mucosa of cylindrical epithelium, flattened as if there had been fluid under tension, set directly against a muscle layer showing both circular and longitudinal fibres. Possibly this is a diverticulum which has amputated itself and become cystic. (F. B. Mallory.)

COMMENT

Without attempting to express a full knowledge of the significance of ileo-cæcal cyst, it is of interest to note that the few cases observed exhibit a constancy of site, a tendency to production of obstruction symptoms, usually during the first year of life, and a perfect simulation of intussusception.

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NECROPSY OF HEALED FRACTURE OF FOREARM HELD BY LANE'S PLATES

In so large a collection of human anatomy as exists in the Hamann Museum of Western Reserve University, there must necessarily be a fund of material upon which can be studied the results of surgical treatment. As a rule such material is of benefit to the local medical community alone. It has seemed to us that this material should be placed at the disposal of a larger public and we propose therefore to publish illustrated notes of specimens committed to our care especially such as demonstrate immediate or end results of disease, injury and treatment, which, in the usual course of events, cannot be adequately studied in the clinic. One such article has already been sent to the ANNALS OF SURGERY,* and our immediate purpose is to add thereto a second dealing with Lane's plates.

The individual here discussed is a white male (Number 973), of twenty-eight years, whose clinical record indeed gives no informa-

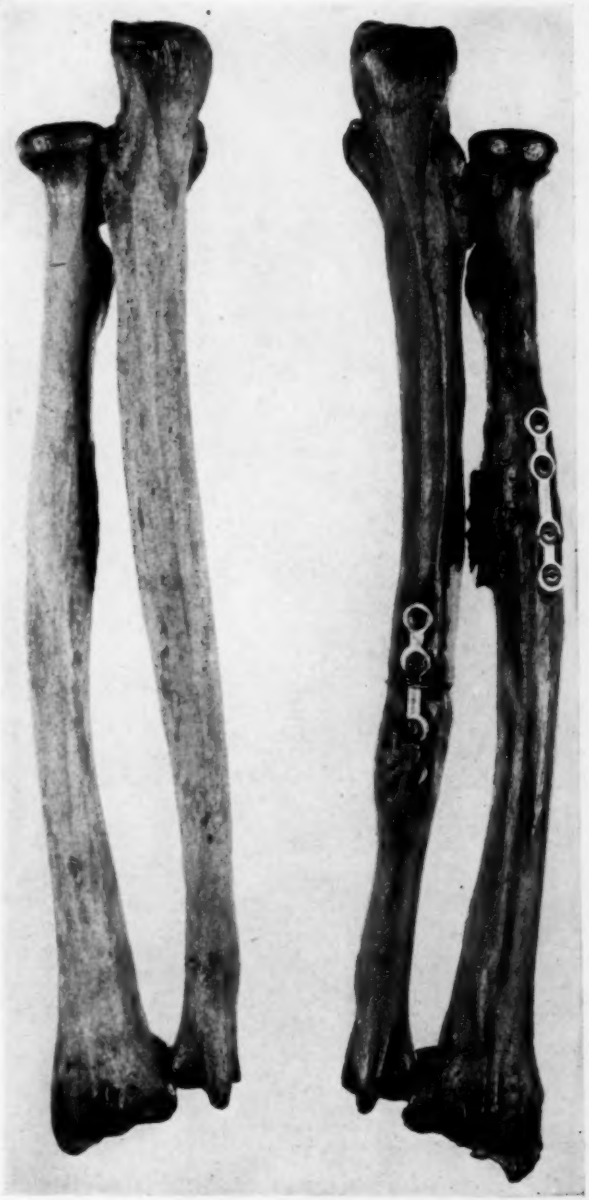

FIG. 1.—Bones of forearms, No. 973, white, male, twenty-eight years. Lane's plates on right radius and ulna. Note the perfect union and position of fragments, the slight exostosis on radius, the small exuberant callus on ulna and the supporting loop of silver wire with its erosion of the bone.

* Todd, T. W., and Iler, D. H.: 1927. The Immediate Appearance of Fracture of the Lower Extremity of the Radius. ANNALS OF SURGERY, vol. lxxxv, p. 956.

tion bearing upon the lesion but who exhibits an old healed fracture of the right radius and ulna. An excellent result has been attained by the use of Lane's plates. Apposition and position of fragments are perfect. No limitation of movement resulted from the injury. Very slight exostosis occurred on the radius alone and permanent exuberant external callus is found in one place only on the ulna. The marrow cavity was not completely restored on either bone. How long previous to death the operation occurred we cannot say, but the skin scar was not adherent to the deeper tissues and hence we may estimate a minimum elapse of five years.

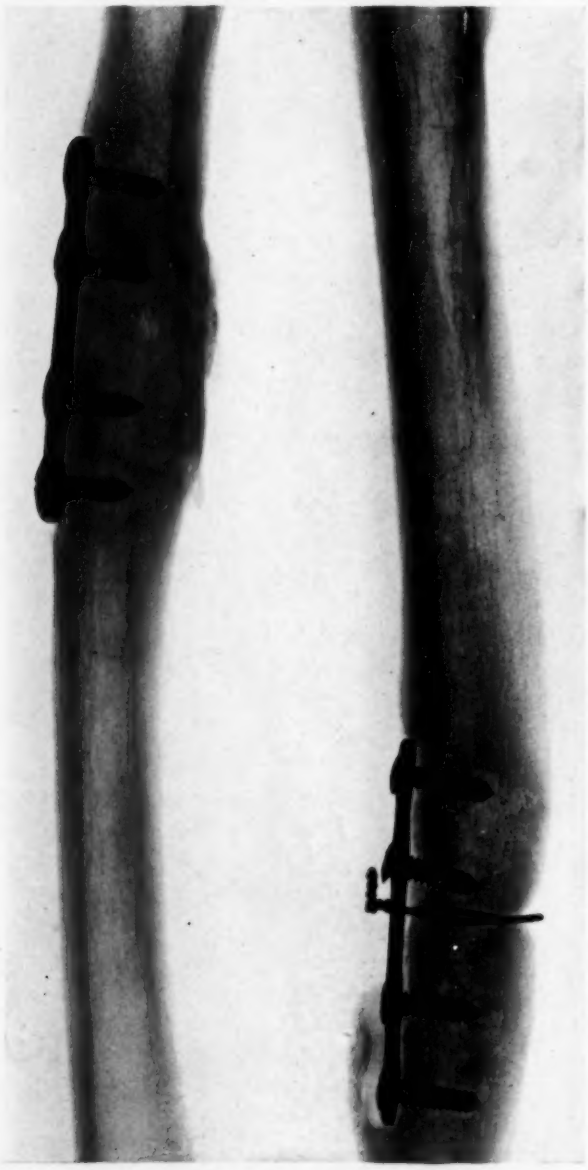

FIG. 2.—Later radiogram of right radius and ulna. Note the secure hold of the screws on the bone tissue, incomplete restoration of marrow cavity on both bones, the erosion by silver wire and exuberant callus on ulna, and the small exostosis on radius.

When the plates were fastened into place on the ulna the screws did not hold quite securely and union was strengthened by a silver wire loop around the fragments. Under this loop a limited erosion of bone has taken place (Fig. 2).

The radiograms (Figs. 1 and 2) show the screws still holding firmly; the threads are not surrounded by any erosion of bone though their presence may well be the cause of incomplete restoration of the marrow cavity. The ulnar screws have apparently secured a firmer hold than at date of operation itself.

In spite of immobility perfect union has taken place between the fragments. We have already presented evidence against the limiting action of

immobility upon bone union and it is unnecessary to discuss the subject further, but it should be mentioned that we hold mobility of fragments to assist in securing union by its action in producing a surrounding traumatic periostitis rather than by any influence upon the fracture faces which indeed we find to be reduced in vitality as the result of mobility.

The skin scar shows that this injury was a simple fracture; there is no indication of suppuration or drainage. The operation was therefore done in a surgically clean field under the best conditions in a young individual in whom bone repair was still active.

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LARGE GUMMA OF THE ABDOMINAL WALL, SIMULATING AN INTRA-ABDOMINAL TUMOR

That syphilitic lesions may involve the various muscles of the body, has long been known. Theodosius [1] recognized this condition as long ago as 1553. Four different types of muscular disturbance arising from syphilis have been enumerated; namely, myalgia, diffuse syphilitic myositis, progressive loss of muscular tone and power, and gummata.

The muscles that most frequently become the seat of gummata are those of the tongue. However, these lesions may occur in other muscles, including the triceps, biceps, gastrocnemius, pectoralis major, sterno-cleido-mastoid, masseter, flexors of the forearm, and the abdominal muscles. Hazen [2] cites a case in which nearly all the muscles of the body were infiltrated with miliary gummata. Such muscles become hard and develop contractures.

While gummata of the abdominal wall do undoubtedly occur, they rarely reach such size as to be confused with an intra-abdominal newgrowth, as in the case we are reporting. After a careful survey of the literature, we have been able to find only three similar cases.

Hunter,[3] in 1905, reported the case of a single woman, aged twenty-three, who noticed an almost painless, gradually increasing swelling about 4 inches in diameter in the left lower quadrant of the abdomen, involving the abdominal wall midway between the umbilicus and the left iliac spine. It was a hard, firm, irregularly rounded mass. The patient denied syphilis and there were no evidences of the disease on physical examination. At operation the cut tissues of the abdominal wall were found to be hard and infiltrated. When a second operation was performed, a typical gumma was found beneath the skin and involving the fascia. Surrounding it, there was a yellowish area of dense infiltration having the consistency of custard and an odor suggestive of degeneration. The muscles and subperitoneal tissue were also infiltrated with dense connective tissue containing areas of degeneration. Under treatment with mercury and potassium iodide, there was rapid improvement and the swelling and induration soon disappeared.

Levin,[4] in 1922, reported the case of a man, aged seventy-four, who complained of loss of weight, epigastric and abdominal pain, and digestive

symptoms. A mass was found in the abdomen and two gastric analyses showed complete achylia gastrica. At first, it seemed to be a case of carcinoma of the stomach; but röntgenologic study proved that the growth had no connection with the stomach, which was normal in outline. Then a small, indurated lesion on the right forearm was found, which on pathologic examination proved to be a gumma. The Wassermann reaction was strongly positive. Under treatment with arsphenamine and mercury rubs, the patient improved rapidly and the abdominal mass disappeared almost completely. Under the circumstances, it is reasonable to suppose that the growth was a gumma of the abdominal wall, simulating an intra-abdominal neoplasm.

Férey,[5] in 1925, published the case of a Greek man, aged thirty-five, known to be syphilitic, who showed distinct prominences in the lower part of the abdominal wall. The entire region below the level of the umbilicus was filled with a hard, nodular, sharply outlined, almost painless, slightly movable mass, corresponding in width to the two recti muscles. On alternate contraction and relaxation of the muscles of the abdominal wall, the position of the tumor remained unchanged; therefore, it was interpreted as being a parietal, extraperitoneal growth. At operation, the abdominal wall was found to be infiltrated with hard, brownish cicatricial tissue, about 2 cm. thick. The underlying peritoneum was smooth. Microscopic examination of a piece of tissue removed for biopsy showed it to consist of slightly changed muscle fibres, separated by strands of sclerotic tissue; there were numerous vessels with thickened walls, surrounded by lymphocytic and plasmocytic infiltration. After eight days' treatment with mercury and arsphenamine suppositories, the tumor became softer. At the end of four weeks of antisyphilitic treatment, the growth had practically disappeared. Férey comments on the rarity of the condition, stating that he could find no analogous case in the literature. It would seem, however, that the cases reported by Hunter and by Levin were essentially similar, as is our own.

From a consideration of the cases cited, it is apparent that the presence of a gumma involving the rectus or other abdominal muscles may give rise to confusion as to whether the growth is inside the abdominal cavity or merely in the abdominal wall. Leas [6] has observed a similar resemblance between myositis of the rectus abdominis muscles and acute intra-abdominal conditions, reporting two cases in which acute appendicitis and acute cholecystitis, respectively, were simulated by rheumatic myositis of the recti muscles.

CASE.—Mrs. R. N., aged sixty-four, housewife, was admitted to the Lenox Hill Hospital, November 29, 1926, complaining of sharp pain in the left lower abdomen of five weeks' duration. She had been married twice, but had only a stillbirth by her first husband and no pregnancies by the second. The menopause had taken place twelve years previously.

The pain was first noticed about October 25, while the patient was reaching upward. Sometimes it felt like the pricking of a needle; at other times, it was like a dull ache, such as follows a severe blow. On occasions it would be severe enough to keep her awake, and sometimes it radiated to the left loin.

The left lower quadrant of the abdomen was found to contain a very large, smooth,

extremely tender mass, which felt elastic and was fairly movable. The rest of the abdomen was slightly tender but not rigid.

On vaginal examination, the mass seemed to lie in the abdominal cavity. It was about the size of a large melon, round, rather soft, and movable. It extended upward from about 2 cm. above the symphysis pubis. The surface felt smooth. On palpation the growth proved to be quite tender. It seemed to be attached at its base either to the uterus or the adnexa, but this lower attachment was difficult to make out. The cervix was smooth, hard and irregular. The whole uterus was of moderate size, movable, and tender over the left fornix. The right adnexa appeared normal.

An X-ray examination, after the ingestion of the opaque meal, was entirely negative. The routine blood Wassermann test was negative. Except for an alkaline reaction and a moderate number of pus cells, the urine was negative. The white blood-cell count was 11,000; there were 78 per cent. polymorphonuclears, 17 per cent. small lymphocytes, and 5 per cent. large lymphocytes.

Before operation, the most likely cause of the tumor was believed to be an ovarian cyst, a large pedunculated uterine fibromyoma, or an omental cyst.

Laparotomy was performed on December 7. A longitudinal incision was made between the symphysis pubis and the umbilicus. When the peritoneal cavity was opened, no tumor was seen; the growth was found to occupy the abdominal wall instead. It was located extraperitoneally within the left side of the abdominal wall, lying between the peritoneum and the muscle and also involving the muscle to a certain extent. A small portion of intestinal loop and omentum was adherent to the site of the inflammatory condition. These adhesions were not disturbed.

On further investigation, the inflammatory condition of the abdominal wall was found to be flattened and to occupy an area about 5 inches in diameter. Several incisions were made. In each case, similar conditions were found; namely, highly inflammatory tissue. At one spot, there was an escape of some sero-sanguineous fluid. Two pieces of tissue were excised for microscopic examination.

The peritoneum was closed with running chromic catgut sutures, the area of the growth in the abdominal wall packed with iodoform gauze, and the abdomen closed in three layers.

Pathologic Examination.—The tissue removed at operation consisted of three small, irregular masses bearing no resemblance to the gross structure of any viscus. Microscopically, one of the fragments was seen to be made up of inflammatory fat tissue, split up into lobules by dense fibrous trabeculæ. The other two fragments consisted largely of compact bundles of fibrous tissue containing islands of fat tissue. On the surface, one of the fragments was covered with a thick layer of suppurating granulation tissue. A more diffuse area of suppuration, not limited by a membrane, was noted in the fibrotic fat tissue. *Pathologic Diagnosis.*—Chronic suppurative inflammation.

Following the operation, there was a profuse purulent discharge from the inflammatory abdominal tissue. For several days, the temperature fluctuated between 103° and 104° F.; the pulse, between 110 and 120. On December 10, the temperature and pulse dropped to normal.

On December 20, an examination of the cerebrospinal fluid was made. It contained 40 cells per cu. mm., all of them lymphocytes; globulin and reducing substances were negative; the Wassermann reaction was strongly positive.

Beginning December 22, the patient received vigorous antisyphilitic treatment with neoarsphenamine and mercury salicylate intramuscularly. On January 16, sulpharsphenamine was substituted for neoarsphenamine, as the patient did not stand the latter preparation well. This treatment was continued until the date of discharge on February 9.

On January 17, the patient stated that she no longer suffered from the severe abdominal pain. The infiltrated mass in the abdominal wall was only half its former size. There was still a persistent sinus from the abdominal wound.

On January 29, the mass in the abdominal wall was only about 2 inches in diameter. There were still two sinuses in the upper and lower openings of the abdominal wound, respectively, each about 2½ inches long.

Under the intensive treatment, signs of mercurialism developed; therefore, mercury treatment was discontinued on January 31. By February 9 the salivation had disappeared and it was possible to resume vigorous antisyphilitic measures. The pseudotumor in the abdominal wall had practically disappeared; that is, it measured only 1 cm. in diameter and was no longer painful. The sinuses were closed. The patient was discharged but advised to return to the dispensary for treatment.

Large gumma of the abdominal wall is so rare a condition as to be easily mistaken for an intra-abdominal tumor. In all four cases here cited, the resemblance to a growth within the abdominal cavity was very great. In Levin's case, the diagnosis of carcinoma of the stomach first suggested itself; in our own case, an ovarian cyst or a large pedunculated fibromyoma.

A positive Wassermann reaction is, of course, of great help in the diagnosis; but the therapeutic test, that is the rapid disappearance of the growth under antisyphilitic treatment, is of still greater value, as was proved by the experiences in all four cases. Evidences found on general examination or the history may suggest a syphilitic origin of the abdominal growth. In Levin's case, a small gumma was found on the right forearm; in Férey's case, there was a frank history of insufficiently treated syphilis. In our own case, the finding of small, unequal, irregular and stiff pupils and the absence of knee-jerks led to the final diagnosis.

The growth appears to take origin from the muscles of the abdominal wall, spreading to involve the fascia and sometimes the skin. Gummata localized in the various muscles of the body are not exceedingly rare; but usually they are small and multiple, and rarely do they become large enough to simulate an intra-abdominal neoplasm.

The results of antisyphilitic treatment are very satisfactory. Within a period of weeks, the enormous growth in the abdominal wall melts away and finally disappears completely. The courses of treatment should, of course, be continued long after the symptoms have disappeared and be guided by their influence on the Wassermann reaction.

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EFFECT OF SECTION OF THE VAGO-SYMPATHETIC NERVES OF THE STOMACH UPON THE SECRETION OF HYDRO-CHLORIC ACID IN THE GASTRIC JUICE

In the ANNALS OF SURGERY of May, 1926, was published an article by Dr. Benedetto Schiassi, of Modena, on the rôle of the pyloric-duodenal nerve supply in surgery of duodenal ulcer. Following the work of Professor Schiassi, his colleague in the same clinic, Professor Foa, instituted a series of researches for observing the modifications of hydrochloric acid secretions of the stomach following resection of the different nerve elements of the stomach after the method of Schiassi.

The first series of researches were performed upon men. Two patients that had been operated by Professor Schiassi himself with the resection of the nerve elements of the pylorus and branches of the vagus, the latter on the highest part of the small curvature of the stomach. Gastro-enterostomy was not performed.

The hydrochloric acid value that was found after the operation was, in relation with that found previously, notably diminished after a year and half.

The second series of researches were executed upon dogs. In certain of these animals Doctor Foa has resected the pyloric nerves, that is to say he has produced a sympathetic discontinuity. The results demonstrate a great increase of hydrochloric secretion after the operation. In other animals he sectioned the branches of the vagus with results that demonstrate a great diminution of the hydrochloric acid secretion. In a third group of animals he performed at the same time the resection of the pyloric nerves and branches of the vagus at the small curvature, noticing a small diminution of the hydrochloric acid secretion.

The researches of Doctor Foa seem to be very interesting and important because the results obtained in men and those resulting from the experiences upon animals are in perfect accord and they prove that in the surgical intervention upon the nerves of the stomach after the methods of Professor Schiassi it is possible to influence at will the hydrochloric acid secretion of the stomach.

Doctor Foa following his experiments concludes that in men, when due to nervous causes there are great and persistent alterations of the hydrochloric acid secretion, surgery can intervene to obtain a permanent equilibrium of the secretion. The report in full may be found in the *Gazzetta Internat. Medico-chirurgica,* May 15, 1927. PAOLO DE VECCHI, M.D.,

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A SINGLE INCISION FOR MULTIPLE INTRAPERITONEAL CONDITIONS COMPLICATING ABDOMINAL HERNIA

Actually there are a large number of people who after a satisfactory operation for hernia later have to come back for operation for appendicitis or other abdominal disease, to say nothing of the much larger number who continue to suffer the indigestion and the recurrent pains of chronic

disease of the appendix or some other intra-abdominal pathology which could have been cured at the same time the hernia was operated upon.

The simple procedure of splitting the muscles about an inch above the internal inguinal canal and inspecting the organs, shows great frequency of associated disease of the appendix and pelvic organs, permits their simultaneous cure, and gives the ideal method of approach to a hernial sac for removal. No one now imagines appendectomy adds danger of wound infection. My own experience in operating upon more than twelve hundred cases of abdominal hernia has been that in approximately 60 per cent. of right inguinal hernia in adults, I have removed through the same incision diseased appendices, and in more than 4 per cent. of nearly two thousand people operated upon for appendicitis, abdominal hernia has been operated upon through the same incision. In women, approximately 3 per cent. of between fifteen hundred and two thousand operated upon for pelvic disease, abdominal hernia was present; and of the women who came primarily for hernia, approximately 80 per cent. had also pathology of the pelvic organs. These figures are lower than the actual frequency of association owing to the fact that in many of the earlier cases, associated diseases were overlooked.

The point to be emphasized is that it is highly proper that when a patient is to be operated on for hernia, appendicitis or pelvic disease, the whole abdomen should be examined before operation and the incision should permit a thorough exploration of the region in the abdomen upon which the patient is to be operated. For years I have advocated the removal of inguinal and femoral hernia through an incision into the abdominal cavity an inch above the neck of the hernia.* This incision gives great satisfaction in securing an easy and complete enucleation of the hernial sac in full view and without danger to neighboring structures (vas deferens, vessels and bladder) and above all with complete and permanent cure of the hernia. Through this incision for hernia of the right side, the appendix is easily removed unless very densely adherent to a cæcum located nearly as high as the umbilicus; and on either side any disease of the tube and ovary is accessible.

My plea now is for a routine adoption of some such incision as this for the discovery and removal of the sac of hernia, the appendix and co-incidental pathology of the female pelvic organs.

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